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WEIGHT-HEIGHT-AGE STANDARDS IN METRIC UNITS FOR AMERICAN-BORN CHILDREN

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Since requests have been received from scientists in various countries for a detailed analytic presentation of the Baldwin-Wood weight-height-age tables, I take this opportunity to publish simultaneously in this country and Germany my original exact averages on nude children in metric units (Tables 1 and 2). The tables were first published in popular form for teachers, health workers, and parents; for this reason the measurements were given in pounds and inches, for children clothed; the weight of clothing was computed by a certain percentage of the exact average for nude weight.[1-2] The form of the table was that previously used by Dr. Thomas D. Wood. The measurements from which the published tables were made were taken, with very few exceptions, in tenths of a centimeter and tenths of a kilogram. Tables 1 and 2 present 498 weight-height-age relationships for boys and 437 for girls between the ages of 6 and 19 years. These, like the original tables, are based on the records selected from those of 74,000 boys and 55,000 girls who had at least five repeated annual or semi-annual measurements; all were presumably healthy American-born children from twelve schools in the eastern and middle portions of the United States.

INCREMENTS IN WEIGHT FOR EACH UNIT IN HEIGHT

A cursory glance at the weights and heights in Tables 1 and 2 shows that there is an appreciable increase in weight for each centimeter in height for boys and girls for each age during the school period. From Tables 3 and 4 it will be noted that the increments in weight for each centimeter in height are greater for tall than for short boys and girls and that they increase gradually for each age until 12 years, after which there is more irregularity. At 16 and 17 years there is a tendency for the reverse to be true of the boys, that is, the larger increments are found for the shorter and the smaller increments for the larger boys. After 17 years, the differences in increments for tall and short boys are less marked. This shifting in the relative size of the increments in weight for each centimeter in height for each age is due to the fact that acceleration in weight during adolescence appears earlier for tall than for short boys. The shifting begins earlier for the girls, at 14, 15, and 16 years of age; this is due to the fact that taller girls have their adolescent acceleration in weight earlier than short girls and tall and short girls earlier than tall and short boys respectively. The slight irregularities in the increments aside from the trends indicated are probably due to the small units of measurement, tenths of a kilogram.

INCREMENTS IN WEIGHT FOR EACH UNIT IN AGE

There is a marked tendency for the increments to increase with age for boys and girls during adolescence. When the increments in height from age to age (Tables 5 and 6) are analyzed it will be noted that from 6 to 11 years there is little or no difference in weight for any given height except a slight tendency for short children to be somewhat lighter than tall, which is indicated in the table by the minus signs. After 12 years there is an increase in weight with age for each centimeter in height in all cases except for a few groups of short children.

WEIGHT-HEIGHT INDICES

When the weight-height-age relationships are expressed in terms of weight-height indices ($\frac{W}{H}$) it at once becomes apparent that for boys and girls the weight at any one age invariably increases proportionately more than the height. During adolescence there is a slight increase with age even when height remains constant. The indices are approximately equal for boys and girls until 138 cm. in height; then the girls excel until approximately 170 cm., after which the boys equal or excel the girls in the proportion of the weight to the height. The range of indices for each age is large. For example, the range for 14 year old boys is from 0.23 to 0.37 and for 12 year old girls, from 0.21 to 0.32. These wide ranges, when age is constant, and the fact that the weight-height ratio increases as height increases show the fallacy of using a single age ratio, or index, for determining a norm with which to compare children.

REFERENCES

1. Baldwin, B. T., and Wood, T. D.—Weight-height-age tables. *Mother & Child,* July 23, 1923. Supplement.
2. Baldwin, B. T.—The use and abuse of weight-height-age tables as indexes of health and nutrition. *J. Am. Med. Ass.,* Jan. 5, 1924, **82** 1–4.

TABLE 1

Weight-Height-Age Standards for American-Born Boys of School Age

Age, years	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Height Centimeters							Weight Kilograms								Height Centimeters
97	15.0*														97
98	15.1*														98
99	15.3*														99
100	15.5*														100
101	15.7*														101
102	15.9*														102
103	16.1*														103
104	16.6														104
105	16.8	16.8*													105
106	17.0	17.0*													106
107	17.2	17.2*	17.2*												107
108	17.5	17.6*	17.4*												108
109	17.8	17.9*	17.7*												109
110	18.3	18.4*	18.2*												110
111	18.9	18.9*	18.8*												111
112	19.4	19.4	19.4*												112
113	19.7	19.7	19.7*												113
114	20.0	20.0	20.0*												114
115	20.4	20.4	20.4*	20.3*											115
116	20.7	20.8	20.7	20.6*											116
117	21.1	21.3	21.1	21.2*											117
118	21.5	21.5	21.4	21.4*											118
119	21.9	21.9	21.8	21.7*											119
120	22.3	22.4	22.2	22.2*	22.2*										120
121	22.5	22.8	22.7	22.7*	22.7*										121
122	22.9	23.2	23.1	23.2	23.2*										122
123	23.4	23.5	23.6	23.6	23.5*										123
124	23.9	23.8	24.1	24.0	23.8*										124
125	24.3	24.3	24.5	24.4	24.2	24.4*									125
126	24.6*	24.9	24.9	24.9	24.8	24.9*									126
127	25.0*	25.3	25.3	25.3	25.4	25.4*	25.4*								127
128		25.9	25.9	25.7	25.9	25.9*	25.9*								128
129		26.4	26.5	26.2	26.4	26.4*	26.4*								129
130		26.9	27.0	26.7	26.8	27.0	26.9*								130
131		27.2	27.4	27.3	27.3	27.5	27.3*								131
132		27.5	27.9	27.8	27.8	28.0	27.7								132
133		28.0*	28.4	28.4	28.3	28.5	28.3	28.5*							133
134		28.5*	28.9	28.9	28.8	28.9	29.0	29.3*							134
135			29.4	29.4	29.3	29.4	29.6	29.9*							135
136			30.0	29.9	29.7	29.8	30.3	30.3*							136
137			30.6	30.4	30.2	30.2	30.9	30.7*							137
138			30.9*	30.8	30.9	30.8	31.3	31.2	31.7*						138
139			31.2*	31.1	31.5	31.5	31.9	31.8	32.0*						139
140			31.6*	31.6	32.2	32.2	32.4	32.4	32.5*						140
141			32.1*	32.3	32.9	32.8	32.9	33.2	33.1*						141
142			32.6*	33.1	33.7	33.5	33.4	34.0	33.7*						142
143				33.6*	34.1	34.2	34.1	34.7	34.5	35.3*					143
144				34.1*	34.4	35.0	34.7	35.2	35.5	35.8*					144
145				34.6*	34.9	35.7	35.4	35.8	36.3	36.3*					145
146				35.3*	35.7	36.2	36.2	36.5	36.9	37.0*					146
147				36.0*	36.5	36.7	36.9	37.1	37.4	37.7*					147
148					37.0	37.2	37.6	37.8	38.0	38.2					148
149					37.5	37.8	38.2	38.4	38.6	38.7					149
150					38.1	38.5	39.0	39.1	39.3	39.3	39.2				150
151					38.7*	39.2	39.5	39.7	40.0	40.3	40.3				151
152					39.4*	39.9	40.0	40.3	40.7	41.3	41.5				152
153						40.5	40.6	41.1	41.6	42.1	42.6				153
154						41.0	41.4	41.9	42.5	42.8	43.7				154
155						41.5	42.1	42.7	43.4	43.5	44.8	46.3*			155
156						42.3*	42.9	43.4	44.0	44.2	45.5	47.2*			156
157						43.2*	43.8	44.1	44.7	44.9	46.3	48.1			157
158						44.0*	44.6	44.9	45.5	45.8	47.3	49.2	51.3*		158
159						44.9*	45.4	45.8	46.4	46.9	48.6	50.3	52.6*		159
160						45.8*	46.2	46.7	47.4	48.0	49.8	51.5	53.9	55.4	160
161							47.4	47.3	48.1	48.8	50.2	52.0	54.4	55.9*	161
162							48.7	48.0	48.8	49.6	50.6	52.5	54.9	56.4*	162
163							49.4	48.8	49.6	50.5	51.2	53.2	55.5	57.0*	163
164							49.6*	49.9	50.5	51.4	52.1	54.1	56.3	57.7*	164
165							49.7*	50.9	51.4	52.3	53.1	55.1	57.1	58.3	165
166								51.4	52.1	53.2	54.1	56.1	57.9	59.3	166
167								51.8	52.9	54.0	55.1	57.0	58.7	60.3	167
168								52.3	53.7	54.8	56.1	57.8	59.4	61.0	168
169								53.1*	54.7	55.7	57.1	58.5	60.0	61.4	169
170								53.9*	55.6	56.5	58.1	59.1	60.5	61.7	170
171									56.7	57.3	58.8	59.9	61.2	62.5	171
172									57.8	58.0	58.5	60.9	62.0	63.4	172
173									58.7	58.7	60.2	61.8	62.8	64.2	173
174									59.2	59.6	61.1	62.7	63.8	65.1	174
175									59.7	60.4	61.9	63.5	64.7	65.9	175
176									60.5	61.2	62.5	64.0	65.3	66.5	176
177									61.4	62.0	62.9	64.3	65.7	67.2	177
178									62.4	62.8	63.4	64.7	66.1	67.8	178
179									63.3*	63.9	64.5	65.4	66.6	68.4	179
180									64.2*	65.1	65.7	66.1	67.1	68.8	180
181										65.8	66.4	66.7	67.7	69.6	181
182										66.3	67.0	67.3	68.3	70.4	182
183										66.9	67.6	68.0	69.0	71.2	183
184										67.5*	68.6	69.1	70.1	71.8	184
185										68.2*	69.5	70.3	71.3	72.5	185
186										68.8*	70.3	71.3	72.2	73.2	186
187										69.3*	71.0	72.3	73.1	73.8	187
188										69.8*	71.7	73.3	73.9	74.4	188

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

Age is taken at the nearest birthday, height at the nearest centimeter, weight at the nearest tenth of a kilogram.

Translated and extended from the Baldwin-Wood tables in the English system of measurement by B. T. Baldwin, Ph.D.

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TABLE 2

Weight-Height-Age Standards for American-Born Girls of School Age

Age, years	6	7	8	9	10	11	12	13	14	15	16	17	18	Height Centimeters
Height Centimeters	weight Kilograms													
97														97
98														98
99														99
100	15.3													100
101	15.7													101
102	16.0	16.0*												102
103	16.1	16.1*												103
104	16.3	16.3*												104
105	16.6	16.6*												105
106	16.8	16.8*												106
107	17.1	17.1												107
108	17.6	17.5												108
109	18.0	17.8												109
110	18.2	18.1	18.2*											110
111	18.4	18.5	18.4*											111
112	18.6	18.8	18.6*											112
113	19.2	19.3	19.1*											113
114	19.7	19.8	19.7*											114
115	20.2	20.1	20.2											115
116	20.6	20.3	20.8											116
117	21.0	20.5	21.3	21.2*	21.2*									117
118	21.4	21.1	21.5	21.5*	21.5*									118
119	21.8	21.8	21.8	21.9*	21.9*									119
120	22.3	22.3	22.2	22.3*	22.3*									120
121	22.7	22.7	22.7	22.7*	22.9*									121
122	23.1	23.1	23.1	23.2	23.4	23.4*								122
123	23.3	23.4	23.5	23.6	23.8	23.7*								123
124	23.4	23.7	23.8	24.2	24.1	24.0*								124
125	23.7	24.1	24.3	24.7	24.6	24.7*								125
126	24.2*	24.4	24.8	25.2	25.3	25.8*								126
127	24.7*	24.8	25.4	25.8	26.0	26.9	27.3*							127
128		25.2	25.8	26.2	26.4	27.2	27.1*							128
129		25.7	26.2	26.6	26.7	27.5	26.9							129
130		26.3*	26.7	27.0	27.1	27.9	27.3							130
131		27.1*	27.4	27.5	27.7	28.2	28.4							131
132		27.8*	28.1	28.0	28.2	28.6	29.5							132
133		28.4*	28.6	28.6	28.8	29.1	29.9							133
134		28.9*	29.1	29.2	29.5	29.6	30.3							134
135			29.6	29.8	30.1	30.1	30.7	31.5*						135
136			30.0	30.4	30.5	30.7	31.0	31.9*						136
137			30.4	31.0	31.0	31.3	31.4	32.2*						137
138			30.9*	31.6	31.6	31.9	32.0	32.8*						138
139			31.4*	32.3	32.3	32.5	32.6	33.4*						139
140				32.9	32.9	33.1	33.2	34.1	34.8*					140
141				33.3	33.6	33.7	34.0	34.9	35.6*					141
142				33.6	34.4	34.3	34.8	35.8	36.5*					142
143				34.2*	35.1	35.0	35.5	36.3	37.4*					143
144				34.9*	35.9	35.6	36.0	36.7	38.4*					144
145					36.6	36.4	36.6	37.2	39.3	41.1*				145
146					36.8	37.3	37.3	38.0	40.3	42.0*				146
147					37.1	38.2	37.9	38.8	41.4	42.8*				147
148					37.6	38.9	38.6	39.5	42.0	43.5*	45.1*			148
149					38.2	39.5	39.2	40.3	42.5	44.0*	45.5*			149
150					38.8	40.2	39.9	41.1	43.0	44.6	45.9*	46.4*		150
151					39.5*	41.0	40.8	41.9	43.8	45.5	46.8*	47.3*		151
152					40.2*	41.8	41.7	42.7	44.6	46.4	47.7*	48.1		152
153						42.6	42.7	43.5	45.4	47.1	48.6	48.9	49.9*	153
154						43.4	43.8	44.2	46.2	47.6	49.4	48.7	50.7*	154
155						44.2	44.8	45.0	47.0	48.1	50.2	50.4	51.4	155
156						44.1*	45.5	45.7	47.5	48.9	50.7	51.1	51.7	156
157						44.0*	46.2	46.5	48.1	49.8	51.1	51.8	52.0	157
158							47.0	47.4	48.7	50.5	51.4	52.2	52.4	158
159							47.9	48.3	49.2	51.0	51.7	52.5	52.7	159
160							48.9	49.2	49.8	51.5	51.9	52.8	53.1	160
161							49.6*	49.9	50.7	52.1	52.6	53.3	53.6	161
162							50.3*	50.6	51.5	52.7	53.2	53.7	54.0	162
163							51.0*	51.4	52.3	53.3	53.8	54.2	54.6	163
164							51.7*	52.2	53.2	53.7	54.3	54.8	55.3	164
165							52.4*	53.1	54.0	54.2	54.8	55.4	55.9	165
166								54.0	54.5	54.6	55.7	56.1	56.6	166
167								54.9	54.9	55.0	56.6	56.9	57.4	167
168								55.6*	55.5	55.7	57.4	57.6	58.2	168
169								56.2*	56.6	56.9	58.2	58.2	59.2	169
170								56.8*	57.6	58.0	58.9	58.9	60.1	170
171								57.2*	58.2	58.8	59.5	59.7	60.7	171
172								57.8*	58.7	59.5	60.0	60.7	61.1	172
173									59.1	60.1	60.5	61.4	61.6	173
174									59.6*	60.5*	60.9*	61.8*	62.3*	174
175									60.0*	60.8*	61.2*	62.1*	62.9*	175
176									60.2*	61.0*	61.6*	62.5*	63.4*	176
177									60.4*	61.2*	62.0*	62.8*	63.7*	177
178									60.6*	61.5*	62.4*	63.2*	64.0*	178
179									60.9*	61.8*	62.7*	63.5*	64.2*	179
180									61.3*	62.2*	63.0*	63.9*	64.4*	180

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

Age is taken at the nearest birthday, height at the nearest centimeter, weight at the nearest tenth of a kilogram.

Translated and extended from the Baldwin-Wood tables in the English system of measurement by B. T. Baldwin, Ph.D.

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TABLE 3

Increments in Weight for Each Centimeter in Height for School Boys, Derived from Weight-Height-Age Standards

Age, years	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Height Centimeters	Weight Kilograms														Height Centimeters
97- 98	0.1*														97- 98
98- 99	0.2*														98- 99
99-100	0.2*														99-100
100-101	0.2*														100-101
101-102	0.2*														101-102
102-103	0.2*														102-103
103-104	0.5*														103-104
104-105	0.2														104-105
105-106	0.2	0.2*													105-106
106-107	0.2	0.2*													106-107
107-108	0.3	0.4*	0.2*												107-108
108-109	0.3	0.3*	0.3*												108-109
109-110	0.5	0.5*	0.5*												109-110
110-111	0.6	0.5*	0.6*												110-111
111-112	0.5	0.5*	0.6*												111-112
112-113	0.3	0.3	0.3*												112-113
113-114	0.3	0.3	0.3*												113-114
114-115	0.4	0.4	0.4*												114-115
115-116	0.3	0.4	0.3*	0.3*											115-116
116-117	0.4	0.4	0.4	0.6*											116-117
117-118	0.4	0.3	0.3	0.2*											117-118
118-119	0.4	0.4	0.4	0.3*											118-119
119-120	0.4	0.5	0.4	0.5*											119-120
120-121	0.2	0.4	0.5	0.5*	0.5*										120-121
121-122	0.4	0.4	0.4	0.5*	0.5*										121-122
122-123	0.5	0.3	0.5	0.4	0.3*										122-123
123-124	0.5	0.3	0.5	0.4	0.3*										123-124
124-125	0.4	0.5	0.4	0.4	0.4*										124-125
125-126	0.3*	0.6	0.4	0.5	0.6	0.5*									125-126
126-127	0.4*	0.4	0.4	0.4	0.6	0.5*									126-127
127-128		0.6	0.6	0.4	0.5	0.5*	0.5*								127-128
128-129		0.5	0.6	0.5	0.5	0.5*	0.5*								128-129
129-130		0.5	0.5	0.5	0.4	0.6*	0.5*								129-130
130-131		0.3	0.4	0.6	0.5	0.5	0.4*								130-131
131-132		0.3	0.5	0.5	0.5	0.5	0.4*								131-132
132-133		0.5*	0.5	0.6	0.5	0.5	0.6								132-133
133-134		0.5*	0.5	0.5	0.5	0.4	0.7	0.8*							133-134
134-135			0.5	0.5	0.5	0.5	0.6	0.6*							134-135
135-136			0.6	0.5	0.4	0.4	0.7	0.4*							135-136
136-137			0.6	0.5	0.5	0.4	0.6	0.4*							136-137
137-138			0.3*	0.4	0.7	0.6	0.4	0.5*							137-138
138-139			0.3*	0.3	0.6	0.7	0.6	0.6	0.3*						138-139
139-140			0.4*	0.5	0.7	0.7	0.5	0.6	0.5*						139-140
140-141			0.5*	0.7	0.7	0.6	0.5	0.8	0.6*						140-141
141-142			0.5*	0.8	0.8	0.7	0.5	0.8	0.6*						141-142
142-143				0.5*	0.4	0.7	0.7	0.7	0.8*						142-143
143-144				0.5*	0.5	0.8	0.6	0.5	1.0	0.5*					143-144
144-145				0.5*	0.5	0.7	0.7	0.6	0.8	0.5*					144-145
145-146				0.7*	0.8	0.5	0.8	0.7	0.6	0.7*					145-146
146-147				0.7*	0.8	0.5	0.7	0.6	0.5	0.7*					146-147
147-148					0.6	0.5	0.7	0.5	0.6	0.5*					147-148
148-149					0.5	0.6	0.6	0.6	0.6	0.5					148-149
149-150					0.6	0.7	0.8	0.7	0.7	0.6					149-150
150-151					0.6*	0.7	0.5	0.6	0.7	1.0	1.1				150-151
151-152					0.7*	0.7	0.5	0.6	0.7	1.0	1.2				151-152
152-153						0.6	0.6	0.8	0.9	0.8	1.1				152-153
153-154						0.5	0.8	0.8	0.9	0.7	1.1				153-154
154-155						0.5	0.7	0.8	0.9	0.7	1.1				154-155
155-156						0.8*	0.8	0.7	0.6	0.7	0.7	0.9*			155-156
156-157						0.9*	0.9	0.7	0.7	0.7	0.8	0.9*			156-157
157-158						0.8*	0.8	0.8	0.8	0.9	1.0	1.1			157-158
158-159						0.9*	0.8	0.9	0.9	1.1	1.3	0.9	1.3*		158-159
159-160						0.9*	0.8	0.9	1.0	1.1	1.2	1.2	1.3*		159-160
160-161							1.2	0.6	0.7	0.8	0.4	0.5	0.5	0.5*	160-161
161-162							1.3	0.7	0.7	0.8	0.4	0.5	0.5	0.5*	161-162
162-163							0.7	0.8	0.8	0.9	0.6	0.7	0.6	0.6*	162-163
163-164							0.2*	1.1	0.9	0.9	0.9	0.9	0.8	0.7*	163-164
164-165							0.1*	1.0	0.9	0.9	1.0	1.0	0.8	0.6*	164-165
165-166								0.5	0.7	0.9	1.0	1.0	0.8	1.0	165-166
166-167								0.4	0.8	0.8	1.0	0.9	0.8	1.0	166-167
167-168								0.5	0.8	0.8	1.0	0.8	0.7	0.1	167-168
168-169								0.8*	1.0	0.9	1.0	0.7	0.6	0.4	168-169
169-170								0.8*	0.9	0.8	1.0	0.6	0.5	0.3	169-170
170-171									1.1	0.8	0.7	0.8	0.7	0.8	170-171
171-172									1.1	0.7	0.7	1.0	0.8	0.9	171-172
172-173									0.9	0.7	0.7	0.9	0.8	0.8	172-173
173-174									0.5	0.9	0.9	0.9	1.0	0.9	173-174
174-175									0.5	0.8	0.8	0.8	0.9	0.8	174-175
175-176									0.8	0.8	0.6	0.5	0.6	0.6	175-176
176-177									0.9	0.8	0.4	0.3	0.4	0.7	176-177
177-178									1.0	0.8	0.5	0.4	0.4	0.6	177-178
178-179									0.9*	1.1	1.1	0.7	0.5	0.6	178-179
179-180									0.9*	1.2	1.2	0.7	0.5	0.4	179-180
180-181										0.7	0.7	0.6	0.6	0.8	180-181
181-182										0.5	0.6	0.6	0.6	0.8	181-182
182-183										0.6	0.6	0.7	0.7	0.8	182-183
183-184										0.6*	1.0	1.1	1.1	0.6	183-184
184-185										0.7*	0.9	0.8	1.2	0.7	184-185
185-186										0.6*	0.8	1.0	0.9	0.7	185-186
186-187										0.5*	0.7	1.0	0.9	0.6	186-187
187-188										0.5*	0.7	1.0	0.8	0.6	187-188

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

TABLE 4

Increments in Weight for Each Centimeter in Height for School Girls, Derived from Weight-Height-Age Standards

Age, years	6	7	8	9	10	11	12	13	14	15	16	17	18	Height Centimeters
Height Centimeters	Weight Kilograms													
97- 98														97- 98
98- 99														98- 99
99-100														99-100
100-101	0.4													100-101
101-102	0.3													101-102
102-103	0.1	0.1*												102-103
103-104	0.2	0.2*												103-104
104-105	0.3	0.3*												104-105
105-106	0.2	0.2*												105-106
106-107	0.3	0.3*												106-107
107-108	0.5	0.4												107-108
108-109	0.4	0.3												108-109
109-110	0.2	0.3												109-110
110-111	0.2	0.4	0.2*											110-111
111-112	0.2	0.3	0.2*											111-112
112-113	0.6	0.5	0.5*											112-113
113-114	0.5	0.5	0.6*											113-114
114-115	0.5	0.3	0.5*											114-115
115-116	0.4	0.2	0.6											115-116
116-117	0.4	0.2	0.5											116-117
117-118	0.4	0.5	0.2	0.3*	0.3*									117-118
118-119	0.4	0.7	0.3	0.4*	0.4*									118-119
119-120	0.5	0.5	0.4	0.4*	0.4*									119-120
120-121	0.4	0.4	0.5	0.4*	0.6*									120-121
121-122	0.4	0.4	0.4	0.5*	0.5*									121-122
122-123	0.2	0.3	0.4	0.4	0.4	0.3*								122-123
123-124	0.1	0.3	0.3	0.6	0.3	0.3*								123-124
124-125	0.3	0.4	0.5	0.5	0.5	0.7*								124-125
125-126	0.5*	0.3	0.5	0.5	0.7	1.1*								125-126
126-127	0.5*	0.4	0.6	0.6	0.7	1.1*								126-127
127-128		0.4	0.4	0.4	0.4	0.3	-0.2*							127-128
128-129		0.5	0.4	0.4	0.3	0.3	-0.2*							128-129
129-130		0.6*	0.5	0.4	0.4	0.4	0.4							129-130
130-131		0.8*	0.7	0.5	0.6	0.3	1.1							130-131
131-132		0.7*	0.7	0.5	0.5	0.4	1.1							131-132
132-133		0.6*	0.5	0.6	0.6	0.5	0.4							132-133
133-134		0.5*	0.5	0.6	0.7	0.5	0.4							133-134
134-135			0.5	0.6	0.6	0.5	0.4							134-135
135-136			0.4	0.6	0.4	0.6	0.3	0.4*						135-136
136-137			0.4	0.6	0.5	0.6	0.4	0.3*						136-137
137-138			0.5*	0.6	0.6	0.6	0.6	0.6*						137-138
138-139			0.5*	0.7	0.7	0.6	0.6	0.6*						138-139
139-140				0.6	0.6	0.6	0.6	0.7*						139-140
140-141				0.4	0.7	0.6	0.8	0.8	0.8*					140-141
141-142				0.3	0.8	0.6	0.8	0.9	0.9*					141-142
142-143				0.6*	0.7	0.7	0.7	0.5	0.9*					142-143
143-144				0.7*	0.8	0.6	0.5	0.4	1.0*					143-144
144-145					0.7	0.8	0.6	0.5	0.9*					144-145
145-146					0.2	0.9	0.7	0.8	1.0	0.9*				145-146
146-147					0.3	0.9	0.6	0.8	1.1	0.8*				146-147
147-148					0.5	0.7	0.7	0.7	0.6	0.7*				147-148
148-149					0.6	0.6	0.6	0.8	0.5	0.5*	0.4*			148-149
149-150					0.6	0.7	0.7	0.8	0.5	0.6*	0.4*			149-150
150-151					0.7*	0.8	0.9	0.8	0.8	0.9	0.9*	0.9*		150-151
151-152					0.7*	0.8	0.9	0.8	0.8	0.9	0.9*	0.8*		151-152
152-153						0.8*	1.0	0.8	0.8	0.7	0.9*	0.8		152-153
153-154						0.8	1.1	0.7	0.8	0.5	0.8	0.8	0.8*	153-154
154-155						0.8	1.0	0.8	0.8	0.5	0.8	0.7	0.7*	154-155
155-156						-0.1*	0.7	0.8	0.5	0.8	0.5	0.7	0.3	155-156
156-157						-0.1*	0.7	0.8	0.6	0.9	0.4	0.7	0.3	156-157
157-158							0.8	0.8	0.6	0.7	0.3	0.4	0.4	157-158
158-159							0.9	0.9	0.5	0.5	0.3	0.3	0.3	158-159
159-160							1.0	0.9	0.6	0.5	0.2	0.3	0.4	159-160
160-161							0.7*	0.7	0.9	0.6	0.7	0.5	0.5	160-161
161-162							0.7*	0.7	0.8	0.6	0.6	0.4	0.4	161-162
162-163							0.7*	0.8	0.8	0.6	0.6	0.5	0.6	162-163
163-164							0.7*	0.8	0.9	0.4	0.5	0.6	0.7	163-164
164-165							0.7*	0.9	0.8	0.5	0.5	0.6	0.6	164-165
165-166								0.9	0.5	0.4	0.9	0.7	0.7	165-166
166-167								0.9	0.4	0.4	0.9	0.8	0.8	166-167
167-168								0.7*	0.6	0.7	0.8	0.7	0.8	167-168
168-169								0.6*	1.1	0.8	0.8	0.6	1.0	168-169
169-170								0.6*	1.0	1.1	0.7	0.7	0.9	169-170
170-171								0.5*	0.6	0.8	0.6	0.8	0.6	170-171
171-172								0.5*	0.5	0.7	0.5	1.0	0.4	171-172
172-173									0.4	0.6	0.5	0.7	0.5	172-173
173-174									0.5*	0.4*	0.4*	0.4*	0.7*	173-174
174-175									0.4*	0.3*	0.3*	0.3*	0.6*	174-175
175-176									0.2*	0.2*	0.4*	0.4*	0.5*	175-176
176-177									0.2*	0.2*	0.4*	0.3*	0.3*	176-177
177-178									0.2*	0.3*	0.4*	0.4*	0.3*	177-178
178-179									0.3*	0.3*	0.3*	0.3*	0.2*	178-179
179-180									0.4*	0.4*	0.3*	0.4*	0.2*	179-180

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

TABLE 5

Increments in Weight for Each Year for School Boys, Derived from Weight-Height-Age Standards

Age, years	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	
Height Centimeters	Weight Kilograms													Height Centimeters
97														97
98														98
99														99
100														100
101														101
102														102
103														103
104														104
105	0.0*													105
106	0.0*													106
107	0.0*	0.0*												107
108	0.1*	-0.2*												108
109	0.1*	-0.2*												109
110	0.1*	-0.2*												110
111	0.0*	-0.1*												111
112	0.0	0.0*												112
113	0.0	0.0*												113
114	0.0	0.0*												114
115	0.0	0.0*	-0.1*											115
116	0.1	-0.1	-0.1*											116
117	0.1	-0.1	0.1*											117
118	0.0	-0.1	0.0*											118
119	0.0	-0.1	-0.1*											119
120	0.1	-0.2	0.0*	0.0*										120
121	0.3	-0.1	0.0*	0.0*										121
122	0.3	-0.1	0.1	0.0*										122
123	0.1	0.1	0.0	-0.1*										123
124	-0.1	0.3	-0.1	-0.2*										124
125	0.0	0.2	-0.1	-0.2	0.2*									125
126	0.3*	0.0	0.0	-0.1	0.1*									126
127	0.3*	0.0	0.0	0.1	0.0*	0.0*								127
128		0.0	-0.2	0.2	0.0*	0.0*								128
129		0.1	-0.3	0.2	0.0*	0.0*								129
130		0.1	-0.3	0.1	0.2	-0.1*								130
131		0.2	-0.1	0.0	0.2	-0.2*								131
132		0.4	-0.1	0.0	0.2	0.3								132
133		0.4*	0.0	-0.1	0.2	-0.2	0.2*							133
134		0.4*	0.0	-0.1	0.1	0.1	0.3*							134
135			0.0	-0.1	0.1	0.2	0.3*							135
136			-0.1	-0.2	0.1	0.5	0.0*							136
137			-0.2	-0.2	0.0	0.7	-0.2*							137
138			-0.1*	0.1	-0.1	0.5	-0.1	0.5*						138
139			-0.1*	0.4	0.0	0.4	-0.1	0.2*						139
140			0.0*	0.6	0.0	0.2	0.0	0.1*						140
141			0.2*	0.6	-0.1	0.1	0.3	-0.1*						141
142			0.5*	0.6	-0.2	-0.1	0.6	-0.3*						142
143				0.5*	0.1	0.1	0.6	-0.2	0.8*					143
144				0.3*	0.6	-0.3	0.5	0.3	0.3*					144
145				0.3*	0.8	-0.3	0.4	0.5	0.0*					145
146				0.4*	0.5	0.0	0.3	0.4	0.1*					146
147				0.5*	0.2	0.2	0.2	0.3	0.3*					147
148					0.2	0.4	0.2	0.2	0.2					148
149					0.3	0.4	0.2	0.2	0.1					149
150					0.4	0.5	0.1	0.2	0.0	-0.1				150
151					0.5*	0.3	0.2	0.3	0.3	0.0				151
152					0.5*	0.1	0.3	0.4	0.6	0.2				152
153						0.1	0.5	0.5	0.5	0.5				153
154						0.4	0.5	0.6	0.3	0.9				154
155						0.6	0.6	0.7	0.1	1.3	1.5*			155
156						0.6*	0.5	0.6	0.2	1.3	1.7*			156
157						0.6*	0.3	0.6	0.2	1.4	1.8			157
158						0.6*	0.3	0.6	0.3	1.5	1.9	2.1*		158
159						0.5*	0.4	0.6	0.5	1.7	1.7	2.3*		159
160						0.4*	0.5	0.7	0.6	1.8	1.7	2.4	1.5*	160
161							-0.1	0.8	0.7	1.4	1.8	2.4	1.5*	161
162							-0.7	0.8	0.8	1.0	1.9	2.4	1.5*	162
163							-0.6	0.8	0.9	0.7	2.0	2.3	1.5*	163
164							0.3*	0.6	0.9	0.7	2.0	2.2	1.4*	164
165							1.2*	0.5	0.9	0.8	2.0	2.0	1.2	165
166								0.7	1.1	0.9	2.0	1.8	1.4	166
167								1.1	1.1	1.1	1.9	1.7	1.6	167
168								1.4	1.1	1.3	1.7	1.6	1.6	168
169								1.6*	1.0	1.4	1.4	1.5	1.4	169
170								1.7*	0.9	1.6	1.0	1.4	1.2	170
171									0.6	1.5	1.1	1.3	1.3	171
172									0.2	1.5	1.4	1.1	1.4	172
173									0.0	1.5	1.6	1.0	1.4	173
174									0.4	1.5	1.6	1.1	1.3	174
175									0.7	1.5	1.6	1.2	1.2	175
176									0.7	1.3	1.5	1.3	1.2	176
177									0.6	0.9	1.4	1.4	1.5	177
178									0.4	0.6	1.3	1.4	1.7	178
179									0.6*	0.6	0.9	1.2	1.8	179
180									0.9*	0.6	0.4	1.0	1.7	180
181										0.6	0.3	1.0	1.9	181
182										0.7	0.3	1.0	2.1	182
183										0.7	0.4	1.0	2.2	183
184										1.1*	0.5	1.0	1.7	184
185										1.3*	0.8	1.0	1.2	185
186										1.5*	1.0	0.9	1.0	186
187										1.7*	1.3	0.8	0.7	187
188										1.9*	1.6	0.6	0.5	188

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

TABLE 6

Increments in Weight for Each Year for School Girls, Derived from Weight-Height-Age Standards

Age, years	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	
Height Centimeters	Weight Kilograms												Height Centimeters
97													97
98													98
99													99
100													100
101													101
102	0.0*												102
103	0.0*												103
104	0.0*												104
105	0.0*												105
106	0.0*												106
107	0.0												107
108	-0.1												108
109	-0.2												109
110	-0.1	0.1*											110
111	0.1	-0.1*											111
112	0.2	-0.2*											112
113	0.1	-0.2*											113
114	0.1	-0.1*											114
115	-0.1	0.1											115
116	-0.3	0.5											116
117	-0.5	0.8	-0.1*	0.0*									117
118	-0.3	0.4	0.0*	0.6*									118
119	0.0	0.0	0.1*	0.0*									119
120	0.0	-0.1	0.1*	0.0*									120
121	0.0	0.0	0.0	0.2									121
122	0.0	0.0	0.1	0.2	0.0*								122
123	0.1	0.1	0.1	0.2	-0.1*								123
124	0.3	0.1	0.4	-0.1	-0.1*								124
125	0.4*	0.2	0.4	-0.1	0.1*								125
126	0.2*	0.4	0.4	0.1	0.5*								126
127	0.1*	0.6	0.4	0.2	0.9	0.4*							127
128		0.6	0.4	0.2	0.8	-0.1*							128
129		0.5	0.4	0.1	0.8	-0.6							129
130		0.4*	0.3	0.1	0.8	-0.6							130
131		0.3*	0.1	0.2	0.5	0.2							131
132		0.3*	-0.1	0.2	0.4	0.9							132
133		0.2*	0.0	0.2	0.3	0.8							133
134		0.2*	0.1	0.3	0.1	0.7							134
135			0.2	0.3	0.0	0.6	0.8*						135
136			0.4	0.1	0.2	0.3	0.9*						136
137			0.6*	0.0	0.3	0.1	0.8*						137
138			0.7*	0.0	0.3	0.1	0.8*						138
139			0.9*	0.0	0.2	0.1	0.8*						139
140				0.0	0.2	0.1	0.9	0.7*					140
141				0.3	0.1	0.3	0.9	0.7*					141
142				0.8	-0.1	0.5	1.0	0.7*					142
143				0.9*	-0.1	0.5	0.8	1.1*					143
144				1.0*	-0.3	0.4	0.7	1.7*					144
145					-0.2	0.2	0.6	2.1	1.8*				145
146					0.5	0.0	0.7	2.3	1.7*				146
147					1.1	-0.3	0.9	2.6	1.4*				147
148					1.3	-0.3	0.9	2.5	1.5*	1.6*			148
149					1.3	-0.3	1.1	2.2	1.5*	1.5*			149
150					1.4	-0.3	1.2	1.9	1.6	1.3*	0.5*		150
151					1.5*	-0.2	1.1	1.9	1.7	1.3*	0.5*		151
152					1.6*	-0.1	1.0	1.9	1.8	1.3*	0.4		152
153						0.1	0.8	1.9	1.7	1.5	0.3	1.0*	153
154						0.4	0.4	2.0	1.4	1.8	0.3	1.0*	154
155						0.6*	0.2	2.0	1.1	2.1	0.2	1.0	155
156						1.4*	0.2	1.8	1.4	1.8	0.4	0.6	156
157						2.2*	0.3	1.6	1.7	1.3	0.7	0.2	157
158							0.4	1.3	1.8	0.9	0.8	0.2	158
159							0.4	0.9	1.8	0.7	0.8	0.2	159
160							0.3*	0.6	1.7	0.4	0.9	0.3	160
161							0.3*	0.8	1.4	0.5	0.7	0.3	161
162							0.3*	0.9	1.2	0.5	0.5	0.3	162
163							0.4*	0.9	1.0	0.5	0.4	0.4	163
164							0.5*	1.0	0.5	0.6	0.5	0.5	164
165							0.7*	0.9	0.2	0.6	0.6	0.5	165
166								0.5	0.1	1.1	0.4	0.5	166
167								0.0	0.1	1.6	0.3	0.5	167
168								-0.1*	0.2	1.7	0.2	0.6	168
169								0.4*	0.3	1.3	0.0	1.0	169
170								1.2*	0.4	0.9	0.0	1.2	170
171								0.9*	0.6	0.7	0.2	1.0	171
172								0.9*	0.8	0.5	0.7	0.4	172
173									1.0	0.4	0.9	0.2	173
174									0.9*	0.4*	0.9*	0.5*	174
175									0.8*	0.4*	0.9*	0.8*	175
176									0.8*	0.6*	0.9*	0.9*	176
177									0.8*	0.8*	0.8*	0.9*	177
178									0.9*	0.9*	0.8*	0.8*	178
179									0.9*	0.9*	0.9*	0.7*	179
180									0.9*	0.8*	0.9*	0.5*	180

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

TABLE 7

Weight-Height Indices for Each Year for School Boys, Derived from Weight-Height-Age Standards

Age, years	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Height Centimeters	Weight														Height Centimeters
97	0.15*														97
98	0.15*														98
99	0.15*														99
100	0.16*														100
101	0.16*														101
102	0.16*														102
103	0.16*														103
104	0.16														104
105	0.16	0.16*													105
106	0.16	0.16*													106
107	0.16	0.16*													107
108	0.16	0.16*	0.16*												108
109	0.16	0.16*	0.16*												109
110	0.17	0.17*	0.16*												110
111	0.17	0.17*	0.17*												111
112	0.17	0.17	0.17*												112
113	0.17	0.17	0.17*												113
114	0.18	0.18	0.18*												114
115	0.18	0.18	0.18*	0.18*											115
116	0.18	0.18	0.18	0.18*											116
117	0.18	0.18	0.18	0.18*											117
118	0.18	0.18	0.18	0.18*											118
119	0.18	0.18	0.18	0.18*											119
120	0.18	0.19	0.18	0.18*	0.18*										120
121	0.18	0.19	0.19	0.19*	0.19*										121
122	0.19	0.19	0.19	0.19	0.19*										122
123	0.19	0.19	0.19	0.19	0.19*										123
124	0.19	0.19	0.19	0.19	0.19*										124
125	0.19	0.19	0.20	0.20	0.19	0.20*									125
126	0.20*	0.20	0.20	0.20	0.20	0.20*									126
127	0.20*	0.20	0.20	0.20	0.20	0.20*	0.20*								127
128		0.20	0.20	0.20	0.20	0.20*	0.20*								128
129		0.20	0.20	0.20	0.20	0.20*	0.20*								129
130		0.21	0.21	0.20	0.21	0.21	0.21*								130
131		0.21	0.21	0.21	0.21	0.21	0.21*								131
132		0.21	0.21	0.21	0.21	0.21	0.21								132
133		0.21*	0.21	0.21	0.21	0.21	0.21	0.21*							133
134		0.21*	0.22	0.22	0.21	0.22	0.22	0.22*							134
135			0.22	0.22	0.22	0.22	0.22	0.22*							135
136			0.22	0.22	0.22	0.22	0.22	0.22*							136
137			0.22	0.22	0.22	0.22	0.22	0.22*							137
138			0.22*	0.22	0.22	0.22	0.23	0.23	0.23*						138
139			0.22*	0.22	0.23	0.23	0.23	0.23	0.23*						139
140			0.22*	0.22	0.23	0.23	0.23	0.23	0.23*						140
141			0.23*	0.23	0.23	0.23	0.23	0.24	0.23*						141
142			0.23*	0.23	0.24	0.24	0.24	0.24	0.24*						142
143				0.23*	0.24	0.24	0.24	0.24	0.24	0.25*					143
144				0.24*	0.24	0.24	0.24	0.24	0.25	0.25*					144
145				0.24*	0.24	0.25	0.24	0.25	0.25	0.25*					145
146				0.24*	0.24	0.25	0.25	0.25	0.25	0.25*					146
147				0.24*	0.25	0.25	0.25	0.25	0.25	0.26*					147
148					0.25	0.25	0.25	0.26	0.26	0.26					148
149					0.25	0.25	0.26	0.26	0.26	0.26					149
150					0.25	0.26	0.26	0.26	0.26	0.26	0.26				150
151					0.26*	0.26	0.26	0.26	0.26	0.27	0.27				151
152					0.26*	0.26	0.26	0.26	0.27	0.27	0.27				152
153						0.26	0.26	0.27	0.27	0.28	0.28				153
154						0.27	0.27	0.27	0.28	0.28	0.28				154
155						0.27	0.27	0.28	0.28	0.28	0.29	0.30*			155
156						0.27*	0.28	0.28	0.28	0.28	0.29	0.30*			156
157						0.28*	0.28	0.28	0.28	0.28	0.29	0.31			157
158						0.28*	0.28	0.28	0.29	0.29	0.30	0.31	0.32*		158
159						0.28*	0.28	0.29	0.29	0.29	0.30	0.32	0.33*		159
160						0.29*	0.29	0.29	0.30	0.30	0.31	0.32	0.34	0.35*	160
161							0.29	0.29	0.30	0.30	0.31	0.32	0.34	0.35*	161
162							0.30	0.30	0.30	0.31	0.31	0.32	0.34	0.35*	162
163							0.30	0.30	0.30	0.31	0.31	0.33	0.34	0.35*	163
164							0.30*	0.30	0.31	0.31	0.32	0.33	0.34	0.35*	164
165							0.30*	0.31	0.31	0.32	0.32	0.33	0.35	0.35	165
166								0.31	0.31	0.32	0.32	0.34	0.35	0.36	166
167								0.31	0.32	0.32	0.33	0.34	0.35	0.36	167
168								0.31	0.32	0.33	0.33	0.34	0.35	0.36	168
169								0.31*	0.32	0.33	0.34	0.35	0.36	0.36	169
170								0.32*	0.33	0.33	0.34	0.35	0.36	0.36	170
171									0.33	0.34	0.34	0.35	0.36	0.36	171
172									0.34	0.34	0.34	0.35	0.36	0.37	172
173									0.34	0.34	0.35	0.36	0.36	0.37	173
174									0.34	0.34	0.35	0.36	0.37	0.37	174
175									0.34	0.34	0.35	0.36	0.37	0.38	175
176									0.34	0.35	0.36	0.36	0.37	0.38	176
177									0.35	0.35	0.36	0.36	0.37	0.38	177
178									0.35	0.35	0.36	0.36	0.37	0.38	178
179									0.35*	0.36	0.36	0.36	0.37	0.38	179
180									0.36*	0.36	0.36	0.37	0.37	0.38	180
181										0.36	0.37	0.37	0.37	0.38	181
182										0.36	0.37	0.37	0.38	0.39	182
183										0.36	0.37	0.37	0.38	0.39	183
184										0.37*	0.37	0.38	0.38	0.39	184
185										0.37*	0.38	0.38	0.38	0.39	185
186										0.37*	0.38	0.38	0.39	0.39	186
187										0.37*	0.38	0.39	0.39	0.39	187
188										0.37*	0.38	0.39	0.39	0.40	188

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

TABLE 8

Weight-Height Indices for Each Year for School Girls, Derived from Weight-Height-Age Standards

Age, years	6	7	8	9	10	11	12	13	14	15	16	17	18	
Height Centimeters	Weight													Height Centimeters
97														97
98														98
99														99
100	0.15													100
101	0.16													101
102	0.16	0.16*												102
103	0.16	0.16*												103
104	0.16	0.16*												104
105	0.16	0.16*												105
106	0.16	0.16*												106
107	0.16	0.16												107
108	0.16	0.16												108
109	0.16	0.16												109
110	0.16	0.16	0.16*											110
111	0.16	0.17	0.16*											111
112	0.17	0.17	0.17*											112
113	0.17	0.17	0.17*											113
114	0.17	0.17	0.17*											114
115	0.18	0.17	0.18											115
116	0.18	0.18	0.18											116
117	0.18	0.18	0.18	0.18*	0.18*									117
118	0.18	0.18	0.18	0.18*	0.18*									118
119	0.18	0.18	0.18	0.18*	0.18*									119
120	0.18	0.18	0.18	0.18*	0.18*									120
121	0.19	0.19	0.19	0.19*	0.19*									121
122	0.19	0.19	0.19	0.19	0.19	0.19*								122
123	0.19	0.19	0.19	0.19	0.19	0.19*								123
124	0.19	0.19	0.19	0.20	0.19	0.19*								124
125	0.19	0.19	0.19	0.20	0.20	0.20*								125
126	0.19*	0.19	0.20	0.20	0.20	0.20*								126
127	0.19*	0.20	0.20	0.20	0.20	0.21	0.21*							127
128		0.20	0.20	0.20	0.21	0.21	0.21*							128
129		0.20	0.20	0.21	0.21	0.21	0.21							129
130		0.20*	0.20	0.21	0.21	0.21	0.21							130
131		0.21*	0.21	0.21	0.21	0.22	0.22							131
132		0.21*	0.21	0.21	0.21	0.22	0.22							132
133		0.21*	0.21	0.21	0.22	0.22	0.22							133
134		0.22*	0.22	0.22	0.22	0.22	0.23							134
135			0.22	0.22	0.22	0.22	0.23	0.23*						135
136			0.22	0.22	0.22	0.22	0.23	0.23*						136
137			0.22	0.23	0.23	0.23	0.23	0.24*						137
138			0.22*	0.23	0.23	0.23	0.23	0.24*						138
139			0.22*	0.23	0.23	0.23	0.23	0.24*						139
140				0.24	0.24	0.24	0.24	0.24	0.25*					140
141				0.24	0.24	0.24	0.24	0.25	0.25*					141
142				0.24	0.24	0.24	0.24	0.25	0.26*					142
143				0.24*	0.24	0.24	0.25	0.25	0.26*					143
144				0.24*	0.25	0.25	0.25	0.25	0.27*					144
145					0.25	0.25	0.25	0.26	0.27	0.28*				145
146					0.25	0.26	0.26	0.26	0.28	0.29*				146
147					0.25	0.26	0.26	0.26	0.28	0.29*				147
148					0.25	0.26	0.26	0.27	0.28	0.29*	0.30*			148
149					0.26	0.26	0.26	0.27	0.28	0.30*	0.30*			149
150					0.26	0.27	0.27	0.27	0.29	0.30	0.31*	0.31*		150
151					0.26*	0.27	0.27	0.28	0.29	0.30	0.31*	0.31*		151
152					0.26*	0.28	0.27	0.28	0.29	0.30	0.31*	0.32		152
153						0.28	0.28	0.28	0.30	0.31	0.32	0.32	0.33*	153
154						0.28	0.28	0.29	0.30	0.31	0.32	0.32	0.33*	154
155						0.28	0.29	0.29	0.30	0.31	0.32	0.32	0.33	155
156						0.28*	0.29	0.29	0.30	0.31	0.32	0.33	0.33	156
157						0.28*	0.29	0.30	0.31	0.32	0.32	0.33	0.33	157
158							0.30	0.30	0.31	0.32	0.32	0.33	0.33	158
159							0.30	0.30	0.31	0.32	0.32	0.33	0.33	159
160							0.30	0.31	0.31	0.32	0.32	0.33	0.33	160
161							0.31*	0.31	0.31	0.32	0.33	0.33	0.33	161
162							0.31*	0.31	0.32	0.32	0.33	0.33	0.33	162
163							0.31*	0.32	0.32	0.33	0.33	0.33	0.33	163
164							0.32*	0.32	0.32	0.33	0.33	0.33	0.34	164
165							0.32*	0.32	0.33	0.33	0.33	0.34	0.34	165
166								0.32	0.33	0.33	0.34	0.34	0.34	166
167								0.33	0.33	0.33	0.34	0.34	0.34	167
168								0.33*	0.33	0.33	0.34	0.34	0.35	168
169								0.33*	0.33	0.34	0.34	0.34	0.35	169
170								0.33*	0.34	0.34	0.35	0.35	0.35	170
171								0.34*	0.34	0.34	0.35	0.35	0.35	171
172								0.34*	0.34	0.34	0.35	0.35	0.36	172
173									0.34	0.35	0.35	0.35	0.36	173
174									0.34*	0.35*	0.35*	0.36*	0.36*	174
175									0.34*	0.35*	0.35*	0.35*	0.36*	175
176									0.34*	0.35*	0.35*	0.36*	0.36*	176
177									0.34*	0.34*	0.35*	0.35*	0.36*	177
178									0.34*	0.34*	0.35*	0.36*	0.36*	178
179									0.34*	0.31*	0.35*	0.35*	0.36*	179
180									0.34*	0.34*	0.35*	0.36*	0.36*	180

*The starred figures represent values based upon theoretical computations, rather than on exact averages.

CONTRIBUTIONS TO ANTHROPOLOGICAL SPLANCHNOLOGY

I. RACIAL STUDIES ON THE LARGE INTESTINE[1]

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A review of anatomical literature as well as that which deals with physical anthropology, shows that so far only meagre attention has been paid to splanchnology from a racial viewpoint (see "Literature"). As natural, the main interests and endeavors of the anthropologists were centered hitherto on the external characteristics of the living man and about the more readily obtainable skeletal remains of the human body.

The reasons why so little in the way of anthropological research has been done on the internal organs and structures, lay chiefly in the dearth of appropriate opportunities and in the scarcity of suitable material.

As might be expected, the first observations in these lines were made in connection with studies in pathological anatomy. At Johns Hopkins and elsewhere in this country and in various institutions in Europe, the weighing and examination of the internal organs became more or less of a routine practice during autopsies. But even this work was and is usually limited to organs such as the heart, spleen, kidneys etc. that can be more readily handled; and it carries with it the great disadvantages, on the one hand, of a lack of sufficient racial material for comparisons, and on the other of dealing with the bodies of diseased persons in many of whom both the body and internal parts have become more or less altered.

The author has been interested in the racial study of the internal human organs for many years, but until the world war his opportunities were equally limited to the dissecting room and *post mortems*. The world war, however, brought me rare opportunities for gathering rich data on the best of material; data which are now gradually being prepared for publication.

This paper represents my first contribution to anthropological splanchnology or splanchnometry, and concerns itself with the question of the large intestine; the results of other comparative anthropological investigations I intend to present later.

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[1] Paper read at the seventy-ninth meeting of the American Association for the Advancement of Science, Section H (Anthropology), Washington, D. C., January 2, 1925.

Am. J. Phys. Anthrop., 1925, Vol. VIII., No. 1.

The studies here dealt with are based on 885 measurements of the large intestine, which were removed from the human body for this purpose.

I will first discuss the Slavic people and the regions inhabited by the Slavs.

THE SERBS

To my statistical data regarding the length of the large intestine in Serbian children, I am adding for comparison the corresponding statistics of Russian children (after Gundobin-Debeles) as well as of German children (Beneke).

TABLE I. MEASUREMENTS OF SERBIAN, RUSSIAN AND GERMAN CHILDREN.

Age	Serbs Colon Length cm.	Russians Colon Length cm.	Germans Colon Length cm.
1–6 month	70.0	70.3	
1–2 year	103.2	88.9	79.6
3–4 year	120.0	90.1	
5–6 year	137.5	96.0	

These measurements indicate that the large intestine of the Serbian children is considerably longer than that found in Germans and Russians of the same age. The average length of colon in Serbian children between the first and sixth year is 120 cm., of the Russians only 91.6 cm.

The measurements obtained by Gundobin and Debeles show, it is seen, a considerable difference from those which I obtained by examinations of Serbian children, who nevertheless belong to the same intestinal type. The main reason lies apparently in the fact that both Russian authors measured the colon in situ, which method leads to errors.

TABLE II. COLON MEASUREMENTS ON SERBIAN YOUTH.

Age	Number	Colon Length cm.	Age	Number	Colon Length cm.
10–15 year	16	169.0	18 year	9	175.3
16 year	13	170.7	19–20 year	13	184.4
17 year	9	177.7			

Between the sixteenth and the twentieth year we notice the average length of the colon to be 175.4 cm. In 6.5% we found a length of 200 cm. or more; in the case of a 16 years old Serbian girl the large intestine measured 210 cm.

TABLE III. COLON LENGTH OF SERBIAN ADULTS.

Age	Number of cases	Colon Length Male cm.	Number of cases	Colon Length Female cm.
21–30 year	15	183.8	15	175.5
31–40 year	11	186.3	11	188.3
41–50 year	17	187.3	17	181.7
51–60 year	27	196.0	12	185.9
61–70 year	25	193.7	9	192.7
71–80 year	9	207.7	8	186.2

The average length of the male adults results in 192.3 cm. and of the female 185 cm. In the above cases (Table No. 3) ranging between 21–80 years, we further observed that 31.4% of the men possessed a colon of 200 cm. or more. About the same percentage (31.9%) was noticed among the women. We may therefore conclude that the Serbs are of dolichocolic type (175–200 cm.) showing in 31% of all the examined cases a hyperdolichocolic condition (200–250 cm) of the large intestine.

The Serbs in Bosnia and Herzegovina (between 20–50 years) have an average colon length of 190.2 cm., but 26.6% showed a length of over 200 cm.

The Serbs in Croatia and Slavonia, of the same age, possess a colon of the average length of 188.7 cm. and 25% of the examined material presented a length of over 200 cm.

The colon measurements of Serbs from South Hungary (Bacska and Banat) ranging between the 20th and 60th year of life, resulted in an average length of 197.5 cm., 44.0% of the total being of the hyperdolichocolic type.

The Serbs and Mohammedans from Novipazar showed a colon of 196.4 cm. average length.

The Montenegrins also belong to the dolichocolic type, having an average colon length of 190.6 cm.

Reviewing these data we may state that the average length of the large intestine of the Serb totals 192.2 cm.

THE CROATS

I principally investigated splanchnometrically the natives of Croatia together with a few from Slavonia. The data obtained follow:

TABLE IV. LENGTH OF LARGE INTESTINE IN CROATIAN PEOPLE.

Age	Number	Colon Length cm.	Age	Number	Colon Length cm.
18–20 year	4	170.0	31–40 year	7	172.8
21–30 year	12	169.1	41–50 year	10	162.0

Should we establish a mean from the above measurements we should arrive at an average length of 168.4 cm. The Croats, therefore, may be included in the orthocolic type. In only 9% of all cases a hyperdolichocolic condition of the large intestine was found.

The Slovenes (Carniola) belong in this respect to the same group as the Croats (mean colon length: 166.6 cm.).

Both peoples, Croats (168.4 cm.) and Slovenes (166.6 cm.) are thus seen to possess on the average a much shorter colon than the Serbs (192.2 cm.).

THE MAGYARS

The following data relate to Magyars from the old Hungarian political unit.

TABLE V. LENGTH OF COLON IN MAGYARS.

Age	Number	Colon Length cm.	Age	Number	Colon Length cm.
18–20 year	15	153.0	31–40 year	10	157.5
21–30 year	11	155.9	41–50 year	27	157.2

The average length of the large intestine of the Magyars nets 155.7 cm., a type of colon that we may designate as brachycolic.

The Magyars (between the 20th and 50th year) born and raised in the southern parts of Hungary, however, show a colon of 190 cm. average length, and therefore approach the length of the colon of the Serbs living in the same provinces. Twenty per cent of these Magyars possessed a large intestine of the hyperdolichocolic type, while the Serbs, as already stated, showed the hyperdolichocolic condition in 44.0%

THE RUMANIANS

The Rumanians of the eastern provinces of Hungary (which are now attached to Rumania) presented the following colon length:

Between the 20th and 30th year: 182.2 cm.

Average: 184.0 cm.

Between the 31st and 50th year: 185.9 cm.

Of the total 26.4% belonged to the hyperdolichocolic class. The Magyars of the same region and of the same age showed a colon averaging 168.6 cm. in length. Here (East Magyars) therefore we also notice an increasing variation of the large intestine even it is not as pronounced as in the case of the South Magyars.

The measurements on *Slovaks* (age 20–50 y.) resulted in an average length of 193.3 cm., with 33.3% of hyperdolichocolic cases.

The *Ruthenians* within the same range possessed a colon length of 186.2 cm. and in 25.0% of the individuals examined there was hyperdolichocoly.

Among the *Poles* living in Galicia, two types could be detected, the brachycolic with an average length of 151.2 cm. and the dolichocolic with an average length of 199.6 cm. It seems that the former type is more prevalent in the western regions of Galicia, the latter being strongly characteristic of the eastern parts of the country. For the present, however, I do not wish to draw any final conclusions from this particular observation. Among the individuals of the dolichocolic class 42.8% had a long colon, the maximum being 230 cm.

Among the *Russians* I noticed the same condition, i.e., individuals with an extremely long colon (up to 250 cm.), an average size of 208.0 cm., with 60.0% belonging to the hyperdolichocolic type, and individuals with a decidedly short colon, averaging 146.4 cm.

The dolichocolic type of the Poles is in almost every respect physically similar to the Russians of the same intestinal classification.

The *Germans* living in the Austrian provinces possess a large intestine with an average length of 161.3 cm. (Upper and Lower Austria: 160.6 cm.; Styria : 164.6 cm.; Tyrol : 158.7 cm.). A hyperdolichocolon was present in only 4.2%. The native Germans in Bohemia showed a colon of 168.6 cm. average length, only 5.2% of the total having an abnormally long colon (hyperdolichocolon).

The following diagram (Fig. 1) is a graphical presentation of the length of the large intestine among the Slavic peoples:

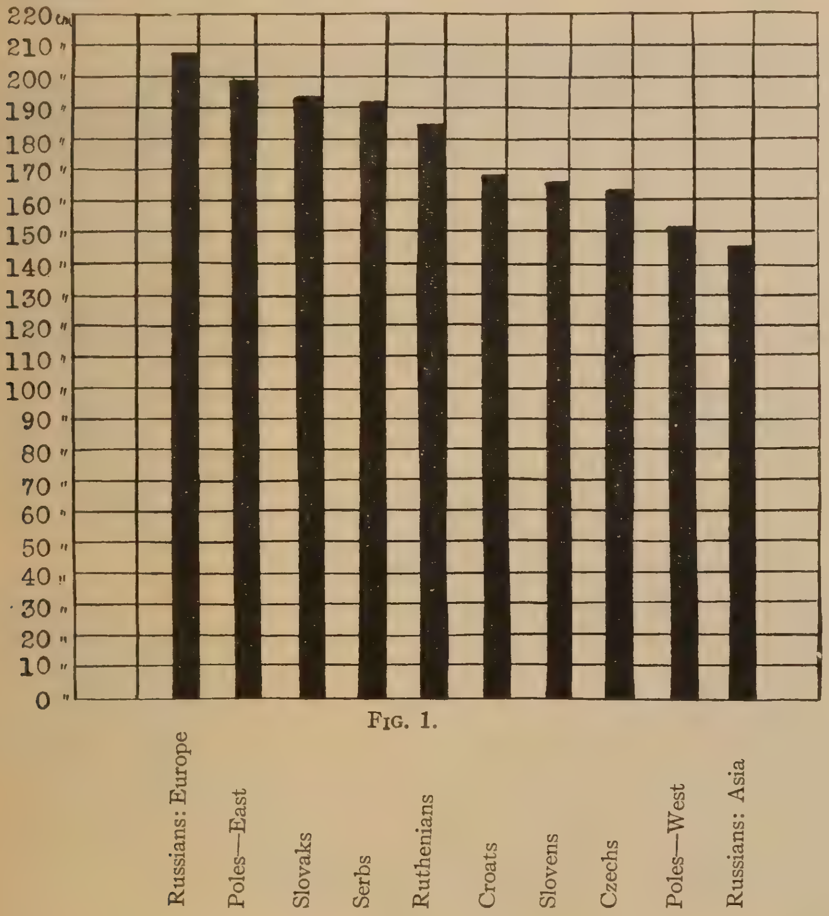

FIG. 1.

The *Czechs* exhibit practically the same conditions as the German inhabitants of Bohemia and the Germans in general. The following table indicates the measurements according to the different ages:

TABLE VI. MEASUREMENTS OF LARGE INTESTINE IN CZECHS.

Age	Number	Colon Length cm.	Age	Number	Colon Length cm.
20–30 year	7	162.1	41–50 year	10	164.0
31–40 year	11	169.8	over 50 year	8	166.6

In 6.0% of the cases examined we met with the hyperdolichocolic condition of the large intestine. The average length amounts to 165.6 cm.

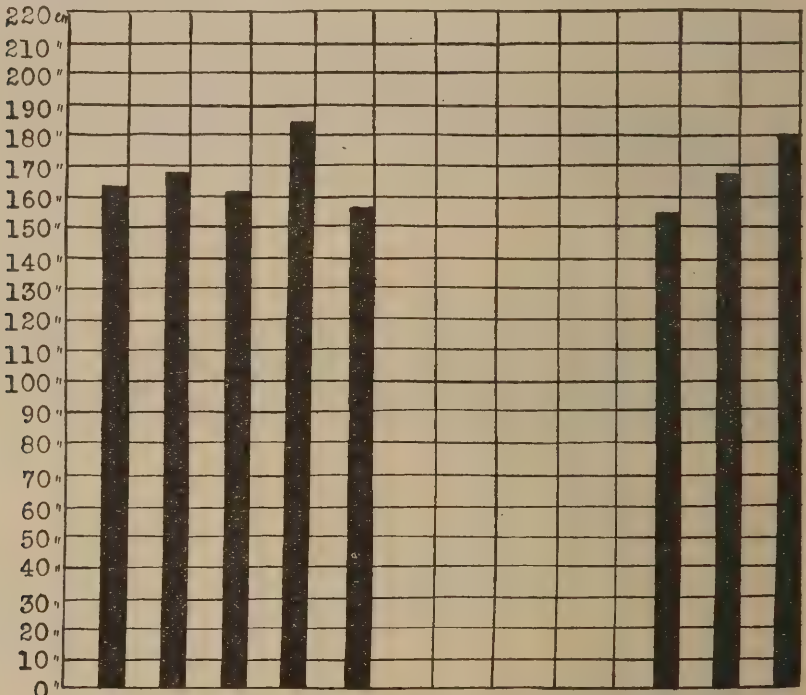

FIG. 2.

Generally speaking in German people we find a colon of the orthocolic type (South Germany: 162.0 cm.; North-West Germany: 164.6 cm.), the average length being 163.3 cm. The Germans of East Prussia, however, show a considerable increase in the length of the large intestine, which reaches the average size of 185 cm., thereby falling into the classification of the dolichocolic type. This variation in length is probably due to the influence (interbreeding, adoption of different modes of living, etc.) of the neighboring peoples, as was observed with the southern and eastern Magyars. The preceding figure (Graph 2) exemfies this fact.

Only 5.5% of the Germans exhibited an abnormally long colon. The measurements made by Beneke (Marburg) in Germany about 46 years ago showed colons ranging from 136.3 to 165.6 cm., results somewhat lower than those of my examinations.

The fact that the inhabitants of German extraction residing in southern Hungary (German settlements) show an average colon length of 158.2 cm. seemed significant; for some reason they were not apparently influenced by the new environment.

THE ITALIANS

These people do not present any uniformity of intestinal length. The Italians from the northern provinces nevertheless seem to possess longer colons than those residing in the southern parts of Italy. In a later communication I will offer more details regarding this point, at the present time I will simply tabulate the measurements in a general way according to the different periods of life.

TABLE VII. MEASUREMENTS OF COLON IN ITALIANS.

Age	Number	Colon Length cm.	Age	Number	Colon Length cm.
19–20 year	14	161.4	31–40 year	49	175.7
21–30 year	77	169.7			

It is evident that the Italians are on the borderline between the orthocolic and dolichocolic types, and undoubtedly represent both types in varying degrees. The dolichocolic type was observed in 38.6% of all the measured cases; 13.5% of these simultaneously exhibited a colon of considerable length attaining a measurement as high as 245 cm.

I am also herewith including data regarding the length of the large intestine among the Balkan *Mohammedans* (partly Turks) arranged according to the countries and regions which they inhabit: Novipazar: 203.3 cm.; Bosnia: 212.0 cm.; Albania: 190.0 cm.; Serb Macedonia: 191.6 cm.

In Bosnia (138.7 cm.) as well as in South-East Russia (156.0 cm.) we occasionally meet with a decided brachycolic type; otherwise the dolichocolic type seemed to predominate among the above mentioned Mohammedans. The abnormal length of the large intestine found in Mohammedans living in various parts of Serbia, seems to indicate an adaptation of the colon to the local mode of living (environmental influences).

I am including the following graphs (No. 3.) to more clearly illustrate the longitudinal variations of the large intestine in the various nations and peoples so far considered.

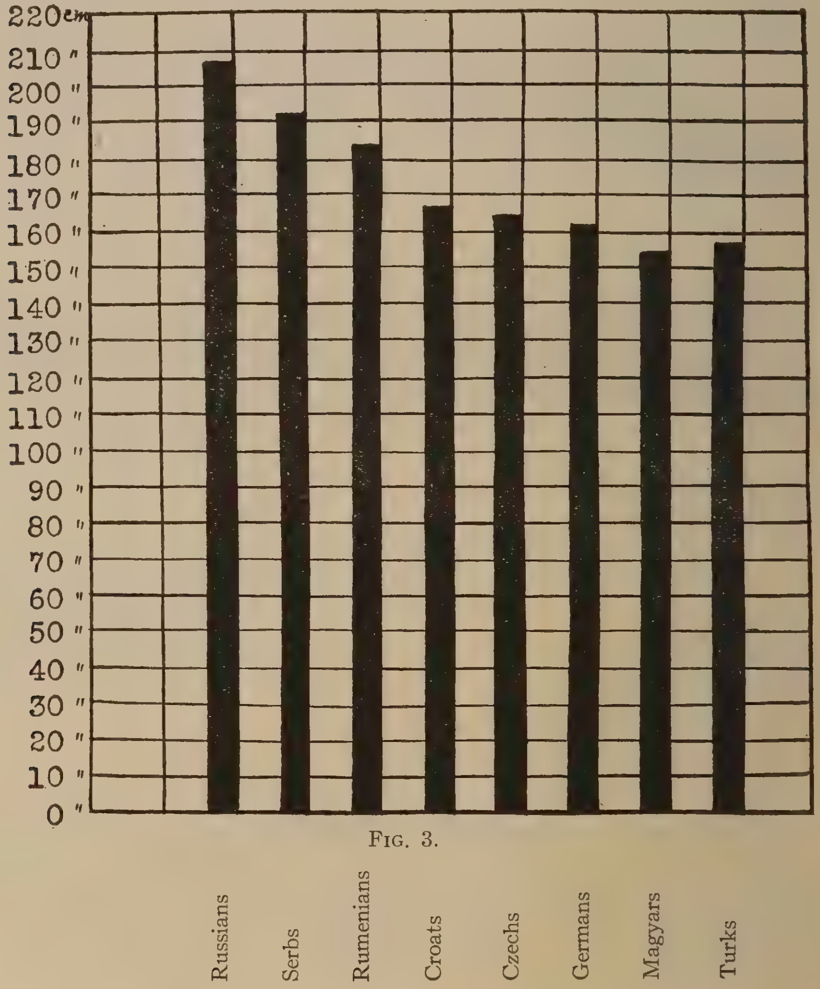

FIG. 3.

In this country (U.S.A.) I had further occasions to make measurements of the large intestine among the descendants of immigrants from various foreign lands. The mean results thus far obtained are: Germans: 158.5 cm.; Czechs: 163.0 cm.; Poles: 186.7 cm. Among the Poles a hyperdolichocolon was noticed in 37.5% of the measured cases.

If we compare these numbers with the results obtained in the corresponding European countries we notice only slight deviations. It would certainly be significant to investigate the question of adaptation of the colon among the American descendants of the dolichocolic Slavs (Russians, Poles, Serbs, etc.), who must necessarily sooner or later assume new modes of living in this country, radically different from their old.

As result of my investigations I feel justified in recommending the following splanchnometric classification:

Brachycolic	Orthocolic	Dolichocolic
Magyars	Croats	Serbs, Montenegrins
Asiatic Turks	Slovenes	Russians
Asiatic Russians	Czechs	Slovaks
West Poles	German Austrians	Ruthenians
	Northwest Germans	East Poles
	South Germans	East Germans
	South Italians	Rumanians
		North Italians
		European Turks

In order to further substantiate the above classification I am adding a percentage ratio of the occurrence of the abnormally long intestine (hyperdolichocolon) in the different peoples with a graphical (Fig. 4) illustration of the facts:

The hyperdolichocolon was found in:

Russians	60.0%	Italians	13.5%
Poles	42.8%	Croats	9.0%
Slovaks	33.3%	Czechs	6.0%
Serbs	31.5%	Germans	5.5%
Ruthenians	25.0%	German-Austrians	4.2%

In a subsequent paper I intend to report upon the role which the sigmoid colon plays in relation to the length of the large intestine, together with a discussion of its longitudinal growth and longitudinal distention from splanchnometrical viewpoint.

SUMMARY

According to the length of their colon, we may classify the peoples examined into three main groups, namely:

(1) Those possessing a short colon (brachycolic: up to 160.0 cm.).

(2) Those showing a medium length (orthocolic: ranging from 160.0 cm. to 175.0 cm.); and

(3) Those presenting a long colon (dolichocolic: over 175 cm.).

The first two types, brachy- and orthocolic, are represented chiefly in the countries and different provinces of Central Europe, while the third type, dolichocolic, is very prevalent in South and East of Europe, including especially the Slavic People.

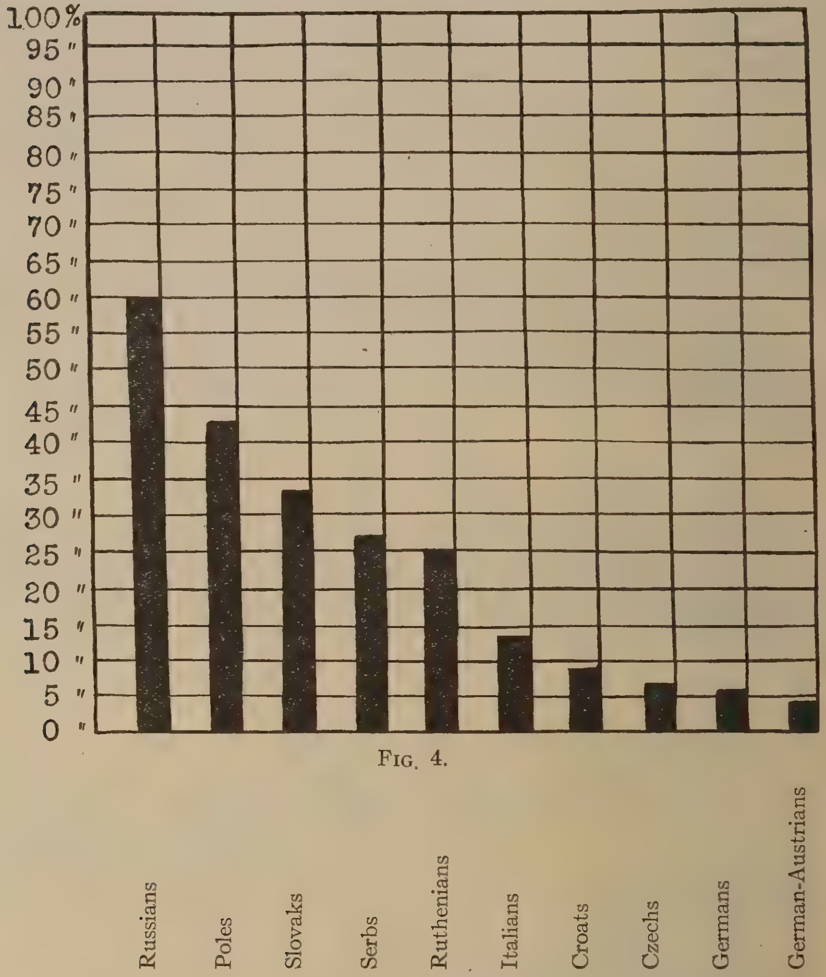

FIG. 4.

That changes in environment (food, mode of living, climatic and social conditions, interbreeding, etc.) may influence the length of the colon, is well shown in the instances of East Prussians (Polish–Russian influence), South Magyars, and the Balkan Turks (Serb environment).

The importance of these studies is further substantiated by the varied occurrence of the very long colons (hyperdolichocolons, measuring above 200 cm.) in the different peoples. Thus the Russians present this condition in 60.0% of all the examined individuals, while on the contrary among the Germans it is encountered in only 5-6%. An elongated colon, a dolichocolic type, appears to be a peculiar characteristic especially of the southern and eastern Slavs of Europe.

BIBLIOGRAPHY

Bardeen (C. R.)—Determination of the size of the heart by means of the X-rays. *Am. J. Anat.*, 1918, XXIII, No. 2.

Bean (R. Bennett)—The weight of the leg in living men. *Am. J. Phys. Anthrop.*, 1919, II, No. 3, 275–282.

——————The weights of the organs in relation to type, race, sex, stature and age. *Anat. Rec.*, 1917, II, No. 6.

Bean (R. Bennett and W. Baker)—Some racial characteristics of the weight of heart and kidneys. *Am. J. Phys. Anthrop.*, 1919, II, No. 3, 265–274.

——————Some racial characteristics of liver weight in man. *Am. J. Phys. Anthrop.*, 1919, II, No. 2, 167–173.

——————Some racial characteristics of the spleen weight in man. *Am. J. Phys. Anthrop.*, 1919, II, No. 1, 1–9.

Bergmann—Grösse des Herzens bei Menschen und Tieren. *Inaug. Diss.*, München, 1884.

Bischoff (E.)—Einige Gewichts und Trockenbestimmungen der Organe des menschlichen Körpers. *Ztschr. f. rationelle Med.*, 1863, 3 Ser., XX, pp. 75.

Blosfield (G.)—Organostathmologie oder Lehre von den Gewichtsverhältnissen des menschlichen Körpers. *A. Henke's Zeitschrift f. Staatsarzneikunde*, Erlangen, 24 Jahrg., LXXXVIII, 1864.

Boyd (J.)—Tables of the weights of the human body and internal organs in the sane and insane. *Philos. Trans. Roy. Soc.*, 1861, CLI.

Buchanan (W. J.) and F. J. Daly—Weights of human viscera (In natives of Bengal). *Ind. Med. Gaz.*, 1902, XXXVII, 56.

Castor (R. H.)—Weight of organs. *J. Trop. Med. & Hyg.*, 1912, XV, No. 2.

Clendinning (J.)—Facts and inferences relative to the condition of the vital organs and viscera in general as to their nutrition in certain chronic diseases. *Medico-chir. Trans.*, Lond., 1838, Ser. 2, III.

Collier (W. D.)—The adaptive changes of heart muscle. *J. Med. Res.*, 1922, XLIII, 207–251.

Dieberg (C.)—Das Gewicht des Körpers und seiner einzelnen Organe. *Casper's Vierteljahresschr. f. gerichtl. Med.*, 1864, XXV.

Engel—Gewichtsbestimmungen von Leichen. *Med. Wchnschr.*, Wien, 1869, No. 63, 64, 65.

Gocke (E.)—Ueber die Gewichtsverhältnisse normale menschlicher Organe. *Inaug. Diss.*, München, 1883.

Greenwood (M.)—A first study of the weight, variability and correlation of the human viscera with special reference to the healthy and diseased heart. *Biometrika*, 1904, III, 63–83.

Greenwood (M.) and J. W. Brown—A second study of the weight, variability, and correlation of the human viscera. *Biometrika*, 1913, IX, 473–484.

Grober (J.)—Ueber die Beziehungen zwischen Körperarbeit und der Masse des Herzens und seiner Teile. *Arch. exp. Pathol.*, 1908, LIX, 424–429.

——————Herzmasse und Arbeit. *Ergebn. inn. Med.*, 1909, III, 34–55.

Hesse (R.)—Das Herzgewicht der Wirbeltiere. *Zool. Jahrb.*, XXXVIII, *Abth. f. allg. Zool. u. Physiol.*, 1921, pp. 243–364.

Howard (W. T.)—Heart hypertrophy. *Johns Hopkins Hosp. Rep.*, 1893, III, 265–300.

Joseph (D. R.)—The ratio betwen the heart weight and body weight in various mammals. *J. Exper. Med.*, 1908, X.

Klatt (B.)—Zur Methodik vergleichender metrischer Untersuchungen, besonders des Herzgewichtes. *Biol. Centralbl.*, 1919, XXXIX, 406–421.

v. Liebig (G.)—Gewichtsbestimmungen der Organe des menschlichen Körpers. *Arch. f. Anat. u. Physiol.*, Jhrg. 1874.

Lorey (C.)—Gewichtsbestimmung der Organe des Kindlichen Körpers. *Jahrb. f. Kinderheilk.*, N. F. 1875, XII.

Mayo Brothers—Surgery of the Liver. *Keene's Surgery*, 1908, III.

Miller (W. S.)—Anatomy of the Liver. *Reference Handbook Med. Sciences*, 1917.

Miloslavich, (E. L.), Hirnhypertrophie und Konstitution, *Beitr. z. path. Anat. v. z. allg. Path.*, 1916, LXII.

Miloslavich, (E. L.), Ein weiterer Beitrag zur pathologischen Anatomie der militärischen Selbstmörder, *Virch. Arch.* 1912, Vol. 208.

Müller (W.)—Die Massenverhältnisse des menschlichen Herzens. Hamburg u. Leipzig, 1883.

Oppenheimer (C.)—Ueber die Wachsthumverhältnisse des Körpers und der Organe. *Ztschr. Biol.*, 1889, XXV, 328–357.

Peacock—Tables of the weights of some of the organs of the human body. *Lond. and Edinb. Monthly J. Med. Sci.*, N. S., 1846–47, I, 101.

Pearl (R.) and A. L. Bacon—Biometrical studies in pathology. I. The quantitative relations of certain viscera in tuberculosis. *Johns Hopkins Hosp. Rep.*, 1922, XXI, Fasc. III, 157–230.

————Biometrical studies in pathology. III. The absolute weight of the heart and spleen in tuberculous persons. *Johns Hopkins Hosp. Rep.*, 1924, XXI, Fasc. V, 297–375.

Prenner—Ueber die Gewichtsverhältnisse der Milz bei verschiedenen Krankheiten. *Inaug. Diss.*, München, 1886.

Pütter (A.)—Studien über physiologische Ähnlichkeit. V. Ähnliche Herzgrössen. *Arch. f. d. ges. Physiol.*, 1918, CLXXII, 367–412.

Reid (John)—Tables of the weights of some of the most important organs of the body at different periods of life. *Lond. & Edinb. Month. J. Med. Sci.*, 1843, III, 295.

Reuter—Grössenverhältnisse des Herzen bei Lungentuberkulose. *Diss.*, München, 1884.

Slutsky (E.)—On the criterion of goodness of fit of the regression lines and on the best method of fitting them to the data. *J. R. Statist. Soc.*, LXXVII, 78–84.

Smidt (H.)—Ueber das specifische Gewicht der Leber und Milz. *Virchows Arch.*, 1880, LXXXII.

Tangl (F.)—Ueber die Hypertrophie und das physiologische Wachsthum des Herzens. *Arch. pathol. Anat.*, 1889, CXVI, 432–456.

Thoma—Untersuchungen über die Grösse und das Gewicht der anatomischen Bestandtheile des menschlichen Körpers in gesunden und in kranken Zustande. Leipzig, 1882.

Vierordt (H.)—Das Massenwachsthum der Körperorgane des Menschen. *Arch. Anat. Physiol., Anat. Abth., Suppl.-Bd.*, 1890, 62–94. Jhrg. 1890.

————Anatomische, physiologische und pathologische Daten und Tabellen, 1908.

Welcker (H.) and A. Brand—Gewichteswerte der Körperorgane bei dem Menschen und den Tieren. *Arch. f. Anthrop.*, 1903, XXVIII.

CRANIAL SUTURE CLOSURE

ITS PROGRESS AND AGE RELATIONSHIP

PART II.—ECTOCRANIAL CLOSURE IN ADULT MALES OF WHITE STOCK

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INTRODUCTION

In a recent paper we have announced our intention of making a complete study of cranial suture closure (6). We have already presented the results of our investigation of endocranial closure in White males and because of their relative constancy, we have proposed these results as a standard of comparison for our work upon ectocranial closure and Negro sutures. Our present task is to set forth as briefly as possible our findings on the subject of ectocranial closure in male White Stock.

It is only after discussing ectocranial closure that one can profitably compare our results with those of others for until now there has been little opportunity for systematic study of the inner surface of the cranium. Indeed in the work of most former writers one cannot be sure what statements refer to endocranial closure and what are the result of ectocranial study: many authors have simply contented themselves by saying that endocranial closure occurs somewhat earlier than and follows practically the same pattern as ectocranial closure.

Our investigation has disclosed the following broad facts.

1. There is no tendency on the part of the sutures to commence to close earlier on either aspect of the cranium. Inspection of our graphs

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demonstrates that when closure begins it is equally evident both ectocranially and endocranially.

2. Ectocranial closure exhibits a slower and more variable progress and there is less evidence of periodic activity than endocranially.

3. Ectocranial closure on the whole is never so complete as endocranial union.

MATERIAL AND METHOD

It may be recalled that out of our large collection of skulls we chose for the study of endocranial suture closure 307 male White skulls, our two criteria being the existence of the entire skeleton and definite knowledge of the age. Of these 307 skulls 40 were rejected because of obvious anomalies in suture closure or for other sufficient reasons. The remaining 267 skulls form the basis alike of our investigations on endocranial closure and on ectocranial union, but for our study of ectocranial closure we have not hesitated to add more recent accessions to our collection since a greater number adds appreciable weight to the results.

There is no need to specify in detail the method of examination: that has been sufficiently described (6). It will be enough to state that the method is in all respects the same as that adopted for the endocranial sutures and once again the graphs are based upon a three-yearly moving average or trend. The trend is a specially sensitive indicator for the commencement of closure: this is noteworthy in the present work for the graphs show what we shall term a spurious commencement in the closure of many sutures. It is the result apparently of an effort of Nature, not well sustained, to start union first on the ectocranial surface.

Lapsed union has been described in our earlier paper. It presents certain well marked features which pick it out without difficulty wherever it occurs. Endocranially it is frequent in the lambdoid suture, especially in the pars lambdica where its occurrence has led previous observers into the erroneous view that closure is incomplete, and in the sagittal suture. Ectocranially it is characteristic of all sutures. It must not be confused with the lethargy in closure which develops at the termination of the period of election, namely shortly after thirty. The restraining influence responsible for lethargic closure is an inhibition but whatever brings about lapsed union is of the nature of a prohibition.

We shall not dwell upon the problem of the discards in this paper. No further discards have occurred and the method of rejection has already been fully described.

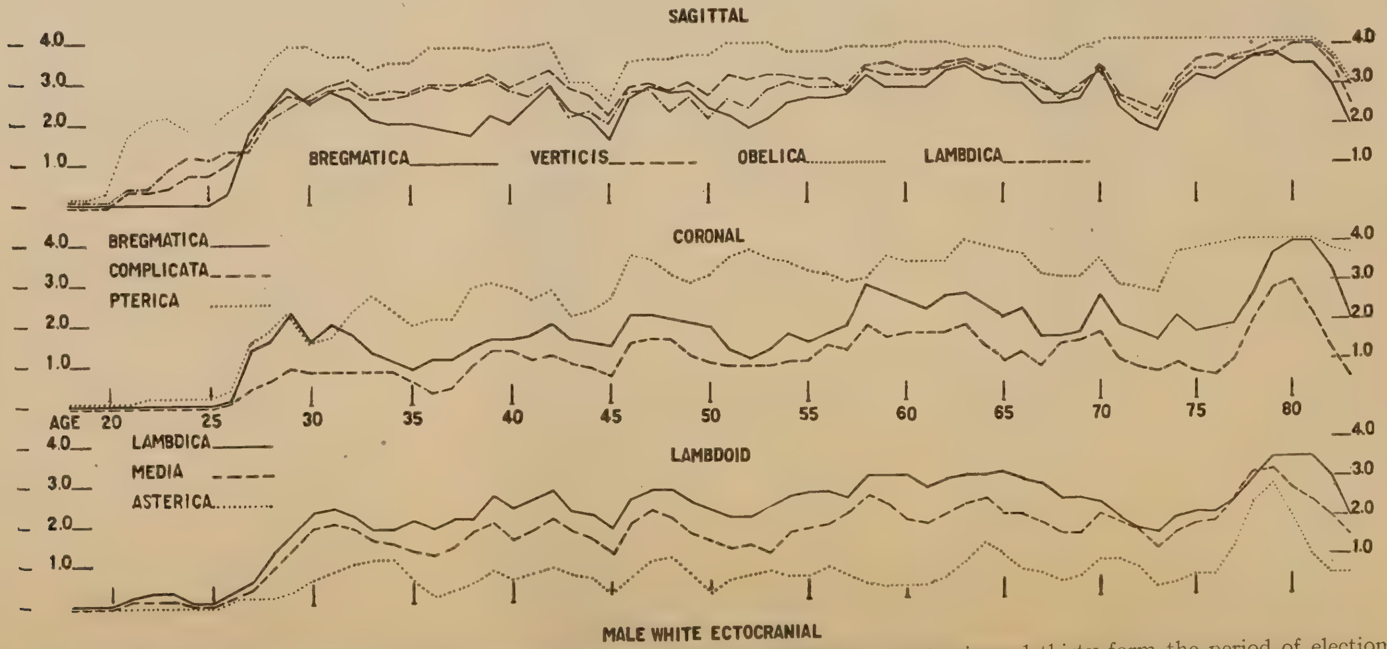

Fig. 1. Ectocranial closure progress in the sutures of the vault. The years between twenty-six and thirty form the period of election for suture closure. The pars obelica of the sagittal has a pattern of its own. Coronal progress slightly precedes lambdoid. The coronal pattern differs somewhat from the endocranial pattern (Fig. 4).

The terminal drop on all our ectocranial graphs is without significance. It results from a meager supply of aged crania and is allowed to remain in the graphs simply to emphasize the plain fact of individual variation.

No reference to right and left sides is made in this work: we find no essential difference in closure pattern and the discussion would have served only to prolong the paper without adding to its value.

Without further preamble we may consider the closure patterns of the several sutures.

I. Sutures of the Vault

THE SAGITTAL SUTURE

Fig. 1.

In spite of the tendency for ectocranial and endocranial closure to commence and continue step by step together, within the limitations outlined above, there is no suture which better displays an attempt at discrepancy. This however affects merely the initial stages of closure. Comparison of ectocranial and endocranial graphs shows a single fundamental pattern for both.

The obelica is a law to itself: the partes verticis and lambdica run together and there is an initial lethargy in the bregmatica. This feature of the bregmatica is not apparent endocranially.

The main points in ectocranial closure are the following.

Closure in the pars obelica commences at twenty years with

(a) a sharp rise to 2.1 at twenty-three,
(b) a lethargic period until twenty-six,
(c) a second period of marked activity terminating at twenty-nine years when closure has reached 3.9 which is of course practical completion.

Closure in the pars lambdica commences at twenty-one years with

(a) a steady rise to 1.2 at twenty-four followed by
(b) a pause until twenty-seven when there occurs
(c) a sharp rise to 2.4 at twenty-nine years and
(d) merely oscillations thereafter.

Closure in the pars verticis commences also at twenty-one years with

(a) a gradual and probably retarded rise to 0.7 at twenty-five,
(b) rapid progress to 2.7 at twenty-nine years and
(c) merely oscillations thereafter.

Closure in the pars bregmatica commences at twenty-six and

(a) rises rapidly to 2.9 at twenty-nine years with
(b) merely oscillations on the graph thereafter.

There are certain features well exemplified by sagittal suture closure which should not be passed over. The partes verticis and lambdica, though separated by the obelica, run a parallel course and the bregmatica, though catching up later, at first presents a pattern of its own. Hence we must not stress location too hard as an influence in determining closure pattern. The paramount influence is probably a much deeper one, of which location is merely one expression. The period of activity between twenty-six and thirty years is strikingly demonstrated and even more arresting is the evident lethargy or inhibition taking place about the latter age. Endocranially we have seen some evidence of secondary periods of activity succeeding this one and there is slight evidence ectocranially also but it is veiled by the failure of union to progress to completion.

The feature which, above all, one would like to emphasize is the plainly marked effort at closure which makes itself evident in the early twenties. If a suture shows no attempt at closure by twenty-two years it will not start until the period of special sutural activity, namely twenty-six years. This is very important: we shall term the phenomenon spurious effort and shall find it in suture after suture. Stevenson has shown the periodicity in epiphysial union (5) and we know that in the early twenties this activity undergoes a marked decline. Our belief is that certain sutures, being ripe as it were, get caught in the last phase of this activity and make their spurious effort. Further progress in their union is lacking for sutural union, like epiphysial union, becomes lethargic. When the real period of activity in sutural closure commences at twenty-six this dormant energy again is let loose and real progressive union takes place.

Endocranially closure in the sagittal suture commences at twenty-two years but a year earlier in the obelica, and by twenty-four has spread to all parts of the suture. In the obelica union progresses rapidly until its completion at twenty-nine but in the other three parts the progress is slow until the end of the twenty-sixth year when a spurt takes place and brings about practical completion of closure by thirty-one. We may safely disregard the final lethargy. The initial and terminal differences between ectocranial and endocranial union are of no particular significance. On both aspects there is the spurious effort in the early twenties quickly inhibited, and the characteristic rapid progress between twenty-six and thirty years.

THE CORONAL SUTURE

(Fig. 1.)

Ectocranially there is a pronounced difference between successive parts of the coronal suture and a tradition has grown up that so great a difference in appearance is accompanied by a real difference in date of union. The actual facts about this suture show no such difference.

Closure in the pars bregmatica commences at twenty-six years with
- (a) a sharp rise to 2.3 at twenty nine and
- (b) no further progress but merely oscillations thereafter.

Closure in the pars complicata also begins at twenty-six with
- (a) a well sustained but not sharp rise to 0.9 at twenty-nine and
- (b) no further progress but merely oscillations in the curve thereafter.

Closure in the pars pterica commences at twenty-two years but
- (a) the initial rise which has reached only 0.4 by twenty-six is obviously of a spurious nature, whereas
- (b) real union then sets in with a sharp rise to 2.3 at twenty-nine and
- (c) continues as an oscillatory rise to 3.8 at about fifty years with
- (d) no further real progress.

There is some justification endocranially for the segregation of the pars pterica from the rest of the suture although it is true that the difference is not great, but it is of the order and in the direction which one would expect. Ectocranially one does not find this difference: the early spurious rise need not be taken into account. The influence, whatever it may be, which totally prohibits completion of ectocranial union—resulting in lapsed union as we have termed the phenomenon—is more pronounced in the upper and middle parts of the suture. Whereas endocranially complete union of the pterica has taken place by forty-one years this is delayed ectocranially until fifty. Apart from this fact there is no real difference in closure on the two cranial aspects in any part of the suture.

THE LAMBDOID SUTURE

(Fig. 1.)

On the endocranial aspect we found it advisable to separate the pars asterica from the remainder of the suture. Ectocranially also there is a distinction and by its nature this distinction serves to accentuate the difference already defined. We may nevertheless set down the main features of lambdoid closure together.

Closure in the pars lambdica commences at twenty-one years with
- (a) a spurious rise which rapidly fades from the graph and is replaced by
- (b) the real commencement at twenty-six which rises to 2.3 at thirty and

(c) is followed merely by oscillations.

Closure in the pars media also commences at twenty-one with
- (a) a spurious rise which rapidly fades and gives place to
- (c) the real commencement at twenty-six which rises to 1.9 at thirty
- (c) and is followed by oscillations only.

Closure in the pars asterica commences at twenty-six with
- (a) a slow rise to 0.6 at thirty
- (b) seeming to be continued to 1.2 at thirty-four but in reality this is nothing more than a swing of the characteristic oscillations.

Lambdoid closure ectocranially occurs then simply between the ages of twenty-six and thirty. The graph shows selective action of the inhibitory influence very well: it is most pronounced in the asterica and least in the lambdica. Ectocranial and endocranial union keep pace with each other in very accurate fashion, allowing for the lapsed union of the ectocranial surface, for in all parts of the suture closure commences at twenty-six and the rapid progress ends at thirty. Further, inhibition seems to have the same relative effect upon the three parts on both aspects.

II. The Circum-Meatal Sutures

In this group of sutures the only one to show any closure activity in the typical period of twenty-six to thirty years is the masto-occipital and it is very slight. The inferior part, which atttains considerable union endocranially before thirty, progresses very little on the outer surface by this age. The spurious start of the parieto-mastoid suture is probably the result of an accidental overflow of the abundant closure energy of the period.

In general, inspection of the graphs shows nothing but a slow, continuous but oscillatory progress. But closer study seems to disclose periods of secondary activity commencing about thirty-seven and sixty years. We happen to know from other researches that there is a significant activity commencing in the skeleton about thirty-seven which results in the formation of rims to the articular surfaces, a feature hitherto confused with pathological lipping. There appears to be no good reason why suture closure may not share in this energy. The cause of the activity about sixty has not yet disclosed itself to us.

The ectocranial features of closure in this group very closely resemble those of endocranial union but owing to a greater effect of the restraining influence all delicate distinctions between the several parts of the various sutures is lost. Endocranially we were able to demonstrate varying degrees of emancipation from the typical pattern as exemplified by the vault sutures. This emancipation reaches its apogee in the squamous suture and becomes less as one follows the spheno-temporal forward or the parieto-mastoid and masto-occipital backward. Ectocranially however squamous, parieto-mastoid and spheno-temporal all commence to unite about thirty-six to thirty-eight and the masto-occipital between twenty-six and twenty-eight. Having in mind the scheme of emancipation so clearly shown on the endocranial aspect it is not difficult to pick out a similar but much less marked closure pattern on the external aspect.

THE MASTO-OCCIPITAL SUTURE

(Fig. 2.)

On the endocranial aspect the third or inferior part of the masto-occipital suture shows quite clearly a pronounced activity in closure during the typical period of suture closure, that is, between twenty-six and thirty years. Ectocranially this marked rise of the curve is not apparent and consequently there is nothing in this graph to arrest attention: all parts of the suture seem to be closing gradually and with more or less regular progress. No justification exists for separating the inferior part from the other two parts in description. No better instance could be cited of the relatively featureless pattern of closure on the ectocranial aspect when compared with endocranial closure. Had we depended upon ectocranial closure for our fundamental investigation, as so many of our predecessors have been compelled to do, we should have found it difficult if not impossible to unravel the tangled skein of suture closure.

The facts concerning union in the masto-occipital suture are the following.

Closure in the pars superior shows

(a) a spurious commencement at twenty-one years quickly fading and

(b) giving place to the real start at twenty-eight which rises to a peak of 0.8 at thirty-two years and continues as

(c) an oscillatory but certain slow progress attaining a final peak of 3.0 in old age.

Closure in the pars media is essentially the same: there is

(a) a spurious rise at twenty-two followed by

(b) the real commencement at twenty-eight which rises to a peak of 1.0 at thirty-two and gives place thereafter to

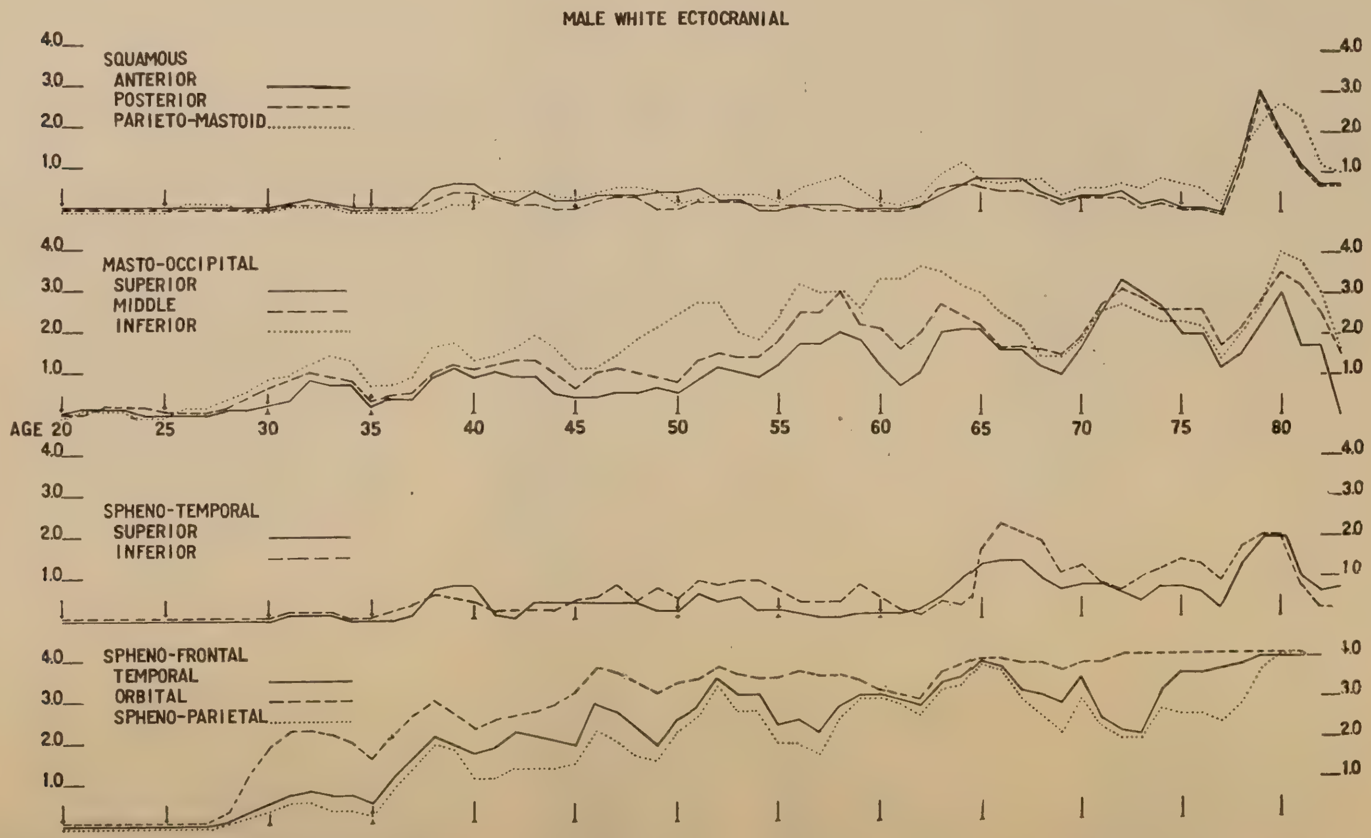

FIG. 2. Ectocranial closure progress in the circum-meatal and accessory sutures. Progress in all these except the spheno-frontal is obviously different from that of the vault sutures. The patterns of the inferior masto-occipital and of the spheno-frontal differ from the corresponding endocranial patterns (Figs. 6, 7). Evidence of subsidiary periods of activity appear in these sutures in the late thirties and about sixty. The final drop is the result of very few aged skulls erratic in their suture closure. Lapsed union is characteristic of all ectocranial sutures.

(c) an oscillatory but nevertheless progressive union reaching a peak of 3.5 in old age.

Closure in the pars inferior presents

(a) the usual spurious rise: it commences at twenty-one years but
(b) the real start is seen at twenty-six and by a rapid rise the curve climbs to 1.4 at thirty-three after which there is
(c) oscillatory progress until a peak of 3.6 is reached at sixty-two with the possibility of complete closure in extreme old age.

Both ectocranially and endocranially the pars inferior commences to unite at twenty six and there is more marked progress endocranially, less marked progress ectocranially, until thirty but the impetus is carried over on both aspects until thirty-three years when an oscillatory appearance of the graph obscures the changes which the suture is undergoing. Endocranially there seems to be some evidence of a rather stationary period terminating in a fresh subsidiary activity at about forty-nine years which continues throughout life thereafter. Ectocranially one cannot distinguish this periodicity.

In the superior and middle parts of the suture closure commences ectocranially at twenty-eight but endocranially not until thirty years. There follows a short period of considerable activity terminating on both cranial aspects at thirty-two, the endocranial aspect showing by then a greater degree of union than the ectocranial. If the periodicity suggested on the endocranial aspect be genuine it is very feeble and does not appear at all on the outer surface of the cranium. There is however on both sides a slow progress maintained throughout the greater part of life.

THE SPHENO-TEMPORAL SUTURE

(Fig. 2.)

Ectocranially there is no advantage in separating the descriptions of the two parts.

Closure in the pars superior shows

(a) a slight and probably spurious commencement at thirty-one years,
(b) the real commencement at thirty-seven with little or no progress
(c) but a secondary spurt in the early sixties with
(d) merely oscillations thereafter.

Closure in the pars inferior also shows

(a) a probably spurious effort at thirty-one years,
(b) the real start at thirty-six, again with little progress but

(c) a secondary period of activity about sixty-five and
(d) oscillations thereafter.

Endocranially there is the same early activity at thirty years which rapidly comes to an end and is probably spurious, the real commencement appearing in both parts at thirty-six. There is little further activity in the pars superior until the spurt occurs in the early sixties but the pars inferior shows no such spurt. In it there is continuous slow progress as on the outer aspect of the cranium, reaching its maximum in the later sixties.

THE SQUAMOUS SUTURE

(Fig. 2.)

On the ectocranial aspect of the cranium as on the endocranial it is unnecessary to separate the anterior from the posterior part of this suture in treatment. The closure curves for both parts and indeed for both aspects run almost parallel. Ectocranially there is an obvious false start in both parts at thirty-one years. These spurious efforts may be disregarded: they are characteristic of all circum-meatal sutures.

Closure in both parts
(a) apart from the spurious effort starting at thirty-one years,
(b) commences at thirty-eight and reaches its peak in one year, namely 0.6 for the anterior part and 0.5 for the posterior. Then follows
(c) a period of oscillation with perhaps
(d) a spurt of secondary activity in the early sixties.

Closure in this suture commences on both sides of the cranium at thirty-seven or thirty-eight and the secondary activity in the early sixties is well marked endocranially. As usual, closure progresses to a much greater degree on the endocranial aspect than on the ectocranial.

THE PARIETO-MASTOID SUTURE

(Fig. 2.)

As on the endocranial surface, closure of the parieto-mastoid suture closely follows union of the squamous. There are two spurious efforts at twenty-six and thirty-one years before the real start. Whether there is simply oscillatory progress or an actual secondary period of activity in the late fifties and early sixties one finds it difficult to decide: the probability is in favor of secondary activity.

Closure starts
(a) after two spurious efforts
(b) at thirty-nine and makes very little progress until there appears

(c) a secondary period of activity in the late fifties and early sixties when a peak of 1.2 is reached at sixty-four and thereafter

(d) merely oscillations.

Endocranially closure starts at thirty-seven and shows the same lethargy until the secondary activity of the fifties.

III. The Accessory Sutures

The two parts of the spheno-frontal suture are not strictly comparable on the two aspects of the cranium and one finds quite a different scheme in the graphs. Endocranially the two parts run a parallel course different from that of the spheno-parietal, but ectocranially the orbital part runs its own course whereas the temporal part and the spheno parietal suture run practically the same course.

One can trace relationship with vault suture pattern in the orbital part alone. The spheno-parietal and the temporal spheno-frontal on the other hand resemble in their graphs the inferior spheno-temporal and in a general way the masto-occipital also in all its parts. One would be very unwise however to inspect these ectocranial graphs alone in the hope of obtaining a mental picture of the suture closure relationships. An indispensible preliminary is the study of our endocranial graphs.

THE SPHENO-PARIETAL SUTURE

(Fig. 2.)

The ectocranial graph for the spheno-parietal suture is an almost exact replica of the endocranial graph but with somewhat less progress year by year.

Closure commences at twenty-eight years

(a) with a slight rise to 0.5 at thirty-one sustained until the

(b) secondary period of activity commencing at thirty-six and reaching 2.0 at thirty-eight but

(c) continuing with diminished and oscillatory vigor until the early sixties.

Endocranially closure begins at twenty-nine and also encounters the delaying influence almost at once. The same spurt in the late thirties is apparent and the continued oscillatory activity. At sixty-five complete closure is attained.

THE SPHENO-FRONTAL SUTURE

(Fig. 2.)

The similarity of the graphs of the two parts, so characteristic of the endocranial surface is not to be found on the ectocranial aspect: nor is there an early start ectocranially.

Closure in the temporal part commences at twenty-eight with
- (a) a gradual rise to 0.7 at thirty-one sustained until thirty-five;
- (b) then a fairly sharp rise to 2.1 at thirty-eight followed by
- (c) a slow oscillatory progress until sixty-five when complete closure may be attained.

Closure in the orbital part commences also at twenty-eight with
- (a) a rapid rise to 2.3 at thirty-one sustained until
- (b) secondary activity sets in at thirty-six and continues until forty-six when the graph reaches 3.8. This activity is followed by
- (c) merely oscillations thereafter.

On the endocranial surface closure in both parts starts at twenty-two, rises to 0.7 at twenty-six and 3.0 by thirty years. After this there is a period of oscillation lasting until sixty-four when complete closure takes place.

The orbital part of the spheno-frontal suture is the only one of the accessory group which at all resembles the pattern of the vault sutures. Its graph recalls those of the lambdica and media of the lambdoid. Endocranially the inferior part of the masto-occipital looks quite like it but there is no resemblance ectocranially. On the other hand the asterica of the lambdoid quite closely resembles in pattern the graphs of the temporal part of the spheno-frontal and of the spheno-parietal. One would easily lose one's way in the maze of ectocranial patterns were it not for the help afforded by the endocranial graphs.

COMPARISON OF STANDARDS

Our work differs fundamentally from that of almost all previous investigators because we seek to establish a definite age relationship in the closure of sutures whereas they, dealing with a number of crania of unknown and quite various age, could base their observations solely upon a general average which they termed a closure tendency. It is apparent that this closure tendency would differ with every collection of crania. Previous workers have been compelled also by circumstances to concentrate the bulk if not the whole of their investigations on the exterior of the cranium: few have had the opportunity of studying any of the endocranial sutures save those of the vault. This being the case it would simply be wearisome and indeed profitless to make comparison with previous results in detail: by their nature they could have merely a temporary value and may now be considered obsolete.

Regarding certain of the major conclusions we should however say a few words. It has been asserted that ectocranial closure is a very different thing from endocranial union, that it commences in a different part of the suture, progresses in a different order and at a different speed. We have shown that, apart from the inferior masto-occipital, the spheno-frontal and in certain respects the coronal, the pattern of the closure graph differs in no essential on the two cranial surfaces. Why these differences should be present in the sutures mentioned we are not yet in a position to explain. As regards precise site of commencement in the several parts of any suture we consider too detailed an insistence as merely a meticulous pedantry: closure commences in the substance of the bone and naturally appears on the surface at rather irregular points and this detail is without significance. We have also shown that lapsed union, so characteristic endocranially in the pars lambdica of the lambdoid suture but by no means uncommon in the sagittal suture, is also characteristic of all the ectocranial sutures and to a much greater degree. Why this should be so we are not yet able to explain. There is no doubt, as our graphs demonstrate, that this lapsed union is the feature which has misled previous workers and brought about the belief that suture closure tends to occur earlier on the endocranial aspect. It is indeed somewhat surprising that the spurious efforts at closure so obvious in our ectocranial graphs, resulting from a precocious attempt at union in certain crania, has not drawn previous workers into the erroneous assertion that closure tends to take place earlier on the exterior of the cranium. The relative order of closure and the date at which each suture commences to unite, as given by former investigators, we would simply turn out of court as unsatisfactory and frequently prejudiced evidence. If the reader will take the trouble to read again at this juncture the historical introduction to our first paper (6 pp. 326–330) he will appreciate better the value to be placed on each of the main investigations previously published upon the subject. We are content to rest our case and will occupy no more space with a discussion which we regard as unnecessary.

THE SKULL OF DESCARTES

In our former paper we have drawn attention to the difference between the significance of this work for modal closure order and dates of a population on the one hand, and for the determination of age in individuals on the other. We have claimed, and we persist in our claim, that while there are individual differences of frequent occurrence in order and date, sometimes even of considerable magnitude, our final published graphs do give the modal order and dates for the population at large. We have already shown by a special investigation how far our conclusions may be depended upon for discussion of an individual skull (6 pp. 379–380). Instead then of continuing this theme in the present paper we propose to discuss a single well known skull, namely that claimed to have belonged to the famous philosopher Descartes.

The authenticity of this cranium has been repeatedly called in question, first by Lenoir in his letter to Cuvier, most recently by the Académie des Sciences in 1912. Verneau (9) gives a brief history of the wanderings of the skull up to the time when it was sent by Berzélius to Cuvier in 1821 by the hand of the Swedish ambassador in Paris. Both Verneau and Richer (4) conclude that the skull is authentic by comparison with the portrait by Franz Hals. This indeed was the basis upon which Cuvier inclined to accept the skull as genuine. It is true that comparison with other portraits has not such a happy result but Miss Tyldesley has shown in her excellent study of the skull and portraits of Sir Thomas Browne that portraits have often been copies one of another and that the artistic convention of the day has brought about alterations in proportions so great that the original resemblance may be and often is entirely lost (8). So far as this method of study permits comparison there seems no good reason to doubt that the skull is indeed that of Descartes.

Ribbe in 1885 (4) took pains to examine the skull carefully and notes that although Descartes was fifty-four years old at the date of his death union of sutures had not yet begun. Presumably this refers to the exterior of the cranium. Comparing the cranium with those of other distinguished men in the Gall collection Ribbe concludes that intellectual men as a rule possess sutures which unite comparatively late in life. I am not in a position to discuss this point but, upon the basis of the results of our study of male white suture closure on both surfaces of the cranium, it is clear that the balance of evidence seems at first to be against the cranium being that of a man of over fifty years. Nevertheless the matter is worthy of further study. The texture of the cranium would yield very valuable information, for the bone in a skull of fifty years differs quite markedly from that of a skull of the third decade to which it ought normally to belong when the sutures show no sign of closure.

I have therefore reviewed our collection to see if I could match the condition found in the presumed cranium of Descartes and I find an apt comparison in No. 758, a White male, native of Austria, who died from a fractured skull at the age of fifty years. This cranium is mentioned in our earlier article (6 p. 360). It shows no endocranial union except in the pars complicata of the right coronal suture. Ectocranially there is no union whatever. The capacity of this cranium is 1555 cc and it belongs to the δ group: that indicates a well filled cranium of a high type as will be shown in a forth-coming paper. The subject has already been discussed in a preliminary manner (7,pp. 250–252). The cranium is characteristically thin but it shows a peculiar texture associated in my experience with liability to fracture. I do not believe that size, texture or thinness is related to the lethargy in suture union: we have indeed the skull of an old Negress of seventy years (No. 152) in which also there is scarcely any trace of suture closure.

The author who, up to the present, has had the greatest experience of suture closure in skulls of known age is de Aranzadi who had at his disposal 1212 skulls, mostly of known individuals (1). This writer realized the magnitude of individual variability in date of suture closure and was forced to the conclusion that the cranium offers no certain sign (in suture closure of course) of the precise age of the individual to which it belonged. With this conclusion we quite agree although we insist that individual variability must not be allowed to obscure the fact that there is a modal progress which holds for the population in general.

So far as Descartes is concerned we would not seek to maintain that the unclosed condition of the sutures constitutes an insuperable bar to the presumption of authenticity for the cranium ascribed to this distinguished man, but we do not believe that his intellectual condition was necessarily associated with the lethargy of union, and we would emphasize strongly that the texture of the bone might well give surer evidence of the decade in which his death occurred.

Having mentioned Sir Thomas Browne we cannot but record our regret that sutures of this thoroughly authenticated cranium do not seem to have received adequate study before re-inhumation. Examination of the published figures yields only presumptive evidence that the sutures on the exterior also exhibit lack of union in spite of the fact that Sir Thomas was seventy-seven years old at the time of his death. This is in marked contrast to the suture condition of Immanuel Kant (2, pp. 373–375). If our interpretation of the cranium of Browne be correct we have one more example of the extent of individual variability. The published photographs show the texture of Browne's cranium to be that of a very old man.

SUMMARY

This paper is a continuation of the work upon suture closure and deals with ectocranial union in White males. We have presented evidence which we believe justifies the following conclusions.

1. Suture closure in general makes itself evident upon both ectocranial and endocranial aspects of the skull at one and the same date. The belief that endocranial closure precedes ectocranial union is without real foundation. To this there are exceptions where union may appear on one aspect a year or two before it is obvious on the other. Such differences are without significance. The pterica of the coronal suture is a case in point.

2. Ectocranial closure progresses more slowly and shows more individual variation than endocranial closure. It is therefore not so reliable as an age indicator.

3. Lapsed union so characteristic of parts of the lambdoid and sagittal endocranial sutures is equally characteristic of all ectocranial sutures. In consequence ectocranial sutures tend to remain in a state of incomplete union, some in very high degree.

4. The years twenty-six to thirty form the period of election for both ectocranial closure and endocranial closure. During this time most of the union which is going to occur takes place. There are however secondary periods of ectocranial activity, namely during the later thirties and about sixty years. These compare well with the evidence of the endocranial sutures. Ectocranially the third subsidiary period in extreme old age, namely in the late seventies, does not appear.

5. The closure patterns on the ectocranial surface are practically the same as those of the endocranial aspect except in the coronal, spheno-frontal and inferior part of the masto-occipital sutures. Why differences should occur in these sutures we are not yet able to explain.

6. Although closure occurs in coronal and lambdoid mainly during the period of election, namely between twenty-six and thirty years, ectocranially as well as endocranially, the coronal has a slight lead in the progress of closure.

7. Precise dates for suture closure and the order of progress are to be found in the text. It is unnecessary to repeat them here but there is no essential change from the endocranial patterns except in the sutures mentioned in paragraph 5.

8. The three types of suture, namely vault, circum-meatal and accessory, are apparent ectocranially but their segregation would not be very clear were it not fully demonstrated on the endocranial aspect.

REFERENCES

1. De Aranzadi (T.)—1913. Algunas observaciones acerca del diagnóstico de la edad en el cráneo. Bol. de la R. Sociedad espanõla de Historia natural. March. (From extract in *L'Anthropologie,* 1916, pp. 161–163.)

2. Kupffer (C.) and Bessel Hagen (F.)—1881. Der Schädel Immanuel Kant's. *Arch. f. Anthrop.*, XIII, 360–410.
3. Ribbe (F. C.)—1885. L'ordre d'oblitération des sutures du crâne dans les races humaines. *Thèse. Paris*, 1–164.
4. Richer (P.)—1913. Sur l'identification du crâne supposé de Descartes par sa comparaison avec les portraits du philosophe. *C. R. Acad. Sc.*, CLVI, 188–191.
5. Stevenson (P. H.)—1924. Age order of epiphyseal union in Man. *Am. J. Phys. Anthrop.*, V11, 53–93.
6. Todd (T. W.) and Lyon (D. W.)—1924. Endocranial suture closure. Part I. Adult males of White Stock. *Am. J. Phys. Anthrop.*, VII, 325–384.
7. Todd (T. W.)—1924. Thickness of the male white cranium. *Anat. Rec.*, XXVII. 245–256.
8. Tyldesley (M. L.)—1923. Sir Thomas Browne: his skull, portraits, and ancestry. *Biometrika.*, XV, 1–76.
9. Verneau (R.)—1912. Le crâne de Descartes. *L'Anthropologie*, XXIII, 640–642.

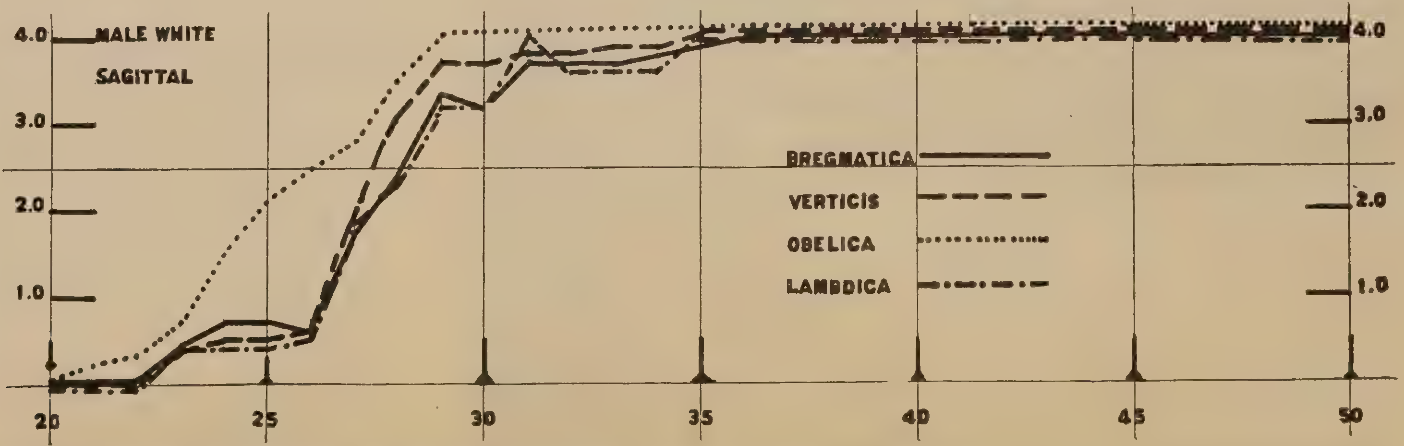

FIG. 3. This and the succeeding four figures of endocranial closure are inserted for comparison. Closure pattern on the endocranial aspect of the sagittal suture. Note the obelica.

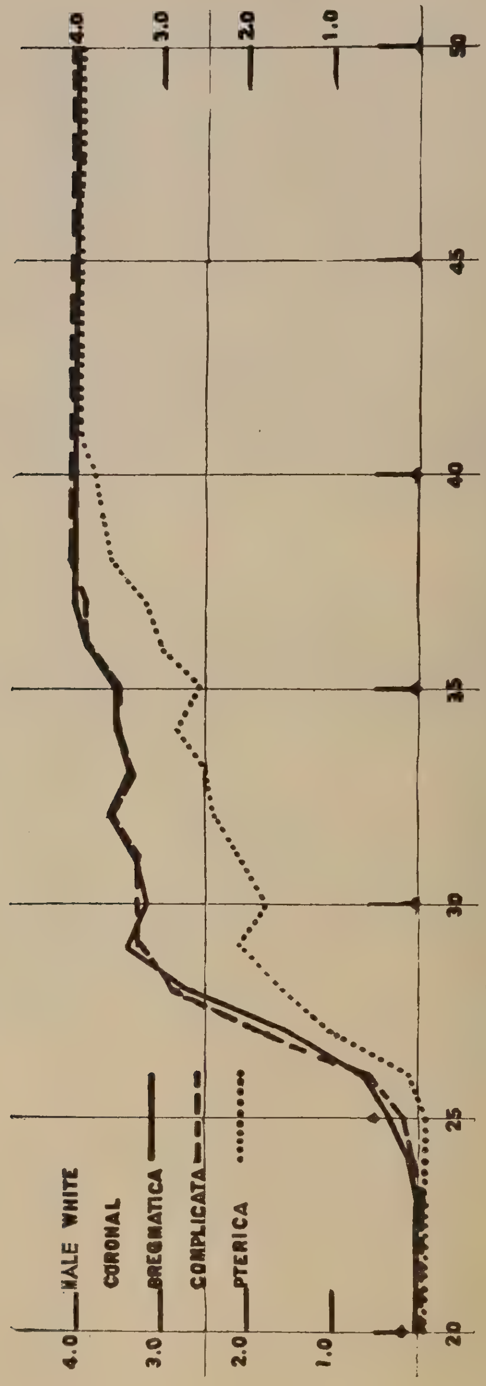

Fig. 4. Endocranial closure progress in the coronal suture.

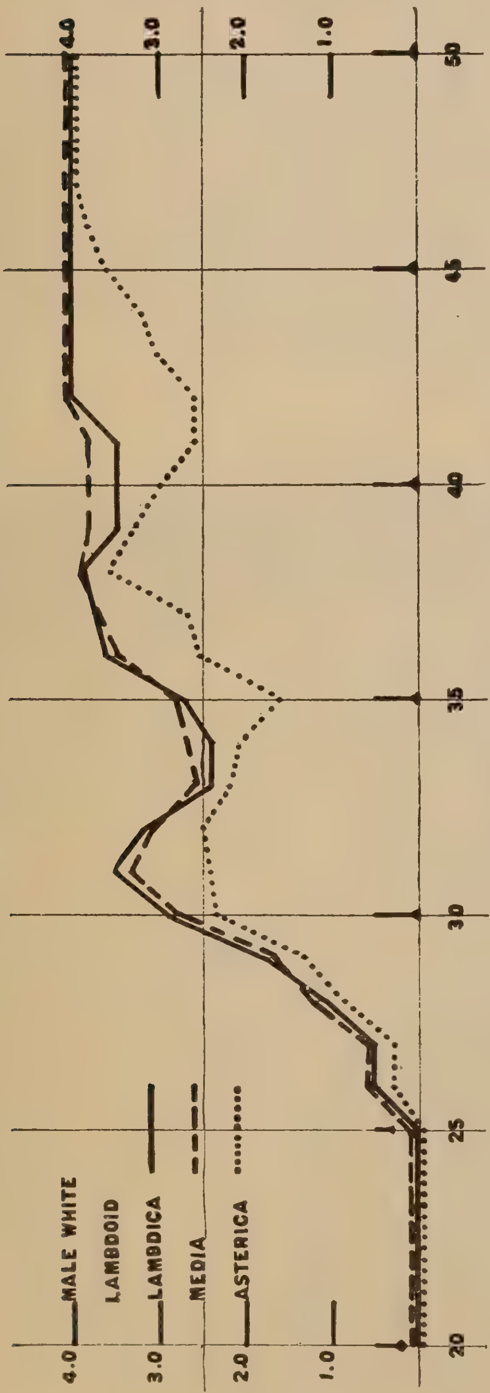

Fig. 5. Endocranial closure progress in the lambdoid suture.

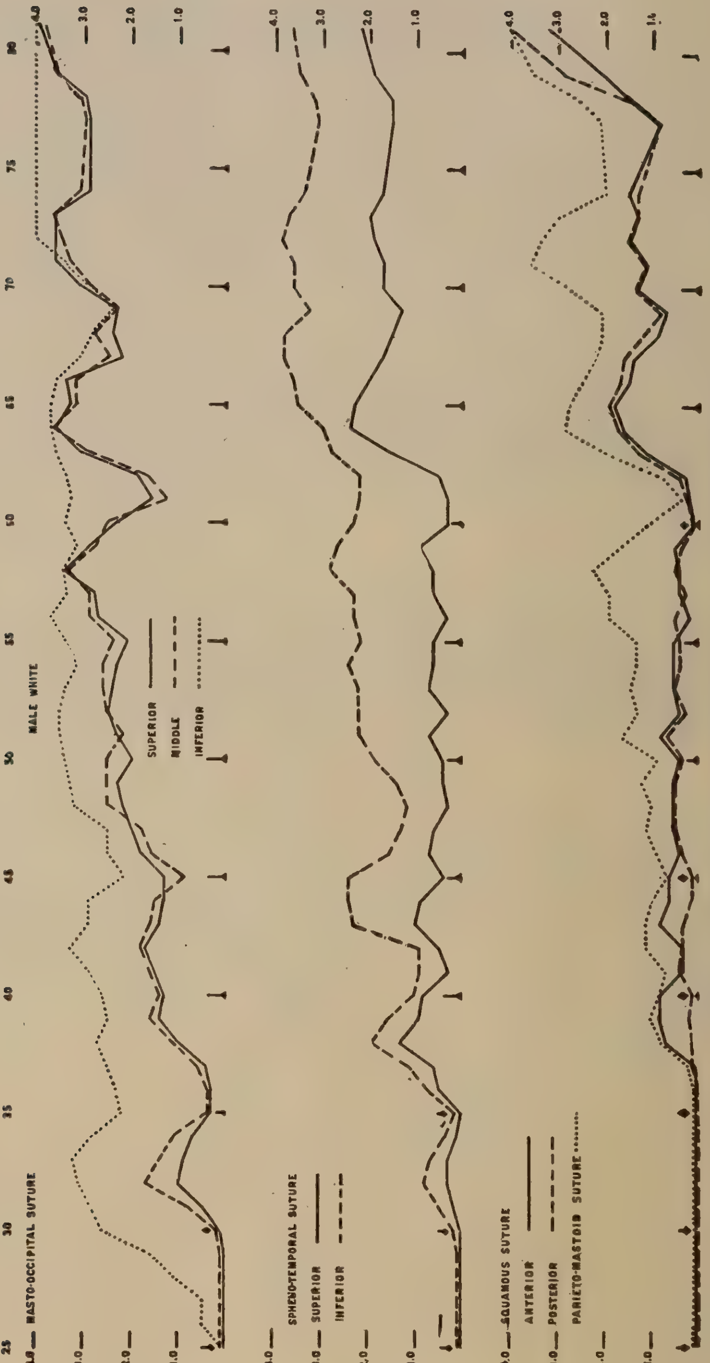

FIG. 6. Endocranial closure progress in the circum-meatal sutures.

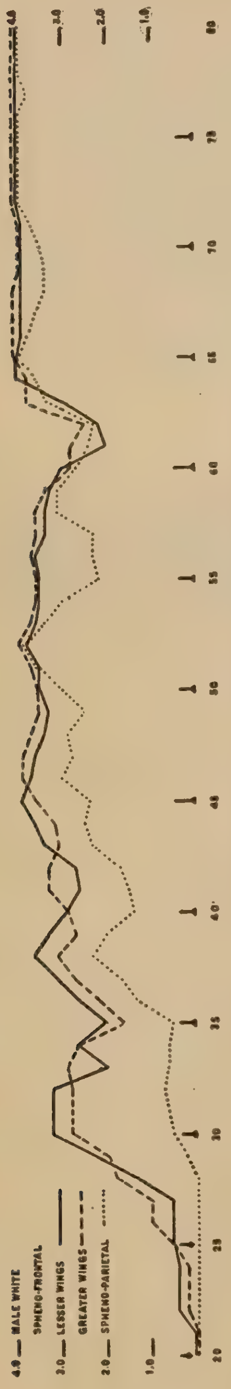

FIG. 7. Endocranial closure progress in the accessory sutures.

CRANIAL SUTURE CLOSURE

ITS PROGRESS AND AGE RELATIONSHIP

PART III.—ENDOCRANIAL CLOSURE IN ADULT MALES OF NEGRO STOCK

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INTRODUCTION

In our two former papers (2, 3) we have given a description of suture closure in adult males of White Stock and we have discussed the observations of previous workers in the light of our findings. As a result we have felt compelled to reject most earlier conclusions upon the subject and set forth a new scheme of closure based upon age relationship, discarding absolutely the current theory of closure tendency. There will be no necessity to review these facts afresh but it is imperative to obtain some information of the effect of Race, or rather of human Stock upon suture closure. For this purpose we require a collection of skulls of known age, bisected so that the interior may be studied with ease, belonging to another type of humanity. We have made careful inquiry among other Institutions for a collection of such a character but without success and have been driven back upon our own collection of Negro males. Now it is popularly supposed that the American Negro is so thoroughly hybridized as to be ineligible as a representative of true Negro Stock. We do not at all agree with this assumption for our considerable experience of the skeletons of these people convince us that there are very few features which can be attributed to the influence of a

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mixed White ancestry. It is not possible in this paper to give the evidence upon which this view is based but on another occasion we hope to set forth all the facts at our disposal. It will be significant however to study suture closure in the American Negro in order to ascertain what features are present in that type of people for comparison with those of White Stock. We shall therefore immediately lay down the results of our investigation, first of American Negro endocranial closure and afterwards of ectocranial closure.

MATERIAL AND METHOD

The skulls of known age utilized for the endocranial survey number 120. However 41 of these were discarded by the same tests used for the White males, leaving only 79 for the actual graph building. With so small a number we should not feel justified in proceeding were it not for two important facts. Since 1921 when this research was planned many skulls of known age have been added to the collection and although these do not enter into the graphs they confirm in every way the conclusions drawn therefrom. Secondly we have the large series of White males from which it has been possible to construct a scheme of closure progress constituting a standard whereby the Negro closure may be judged. Thus the deficiency in number is to a large extent made good.

Since there is nothing new in the method of rejection of abmodal Negro skulls we shall not dwell upon it but merely remark that whereas it was necessary to reject 13.0 per cent of White male crania we have found that we had to discard 34.2 per cent of the Negroes. At first sight this might seem significant evidence of hybridization. Unfortunately for such a view the finished graphs exhibit essentially the same features as the White graphs. Hence one would be logically compelled to hold that only some 30.0 per cent of American Negroes could be of pure blood. But rejection in this series is mostly on account of delayed union in some part or other of the suture complex, and the majority of the White discards were rejected for the same reason. Consequently it is evident that the modal closure pattern is in general the same for Negroes as for Whites but individual variability is more characteristic of the Negro. One cannot too strongly insist upon the importance of this conclusion the grounds for which will become apparent as we proceed.

The reader should recall that we subdivide cranial sutures into three groups. The sagittal, coronal and lambdoid constitute the sutures of the vault; the spheno-frontal and spheno-parietal are the accessory group; the remaining sutures form the circum-meatal group.

SUTURES OF THE VAULT

1. THE SAGITTAL SUTURE (Figs. 1 and 2)

The moving average of endocranial sagittal closure in the Negroes (Fig. 1) shows a much more uniform curve than that of the Whites. The salient features however are the same. Commencement of closure occurs at twenty-two and continues slowly until twenty-six when it has reached practically the same point as in the Whites. Thence-forward the curve becomes steeper and by thirty-one years closure is completed. In the male Whites closure was practically complete at this age although the terminal phase of closure was somewhat protracted.

Following the scheme initiated for the male Whites we may tabulate the results in the ensuing manner:—

Male Negro endocranial sagittal closure.

Closure commences at twenty-two with

(a) a gradual rise to 1.0 at age twenty-six, followed by

(b) a sharper steady rise to

(c) complete closure at thirty-one years.

The skull tabulation is the following:—

Age	Period	Number of skulls			
		Retained		Rejected	
17–21	prê-(a)	8		2	
22–25	(a)	15	27	6	14
26–30	(b)	12		8	
31–76	(c)	44		25	

Total retained in series	79
Total rejected	41
Grand total	120
Percentage of discards to grand total	34.2
Percentage of discards (a)–(b) inclusive on total of these periods	34.1

Now let us examine the discards of thirty years and under. No. 693, age 18, shows complete closure of all the sagittal suture endocranially except the bregmatic part which is only one quarter united; closure of the middle part of each coronal, and of the lambdoid part of each lambdoid together with the middle part of the right lambdoid. The asteric part of the right lambdoid is half united. There is no closure at all in the bregmatic part of each coronal, in the pteric part of the left coronal and in the asteric part of the left lambdoid. The pteric part of the right coronal is one quarter united. The middle part of the left lambdoid is three-quarters closed. This condition of suture closure is clearly anomalous when we see that in no other instance of the remaining nine crania of less than twenty-two is there any closure at all. Beyond some slight acceleration the symphysis pubis shows no unusual characters. Acceleration of differentiation to about twenty years is indeed apparent all over

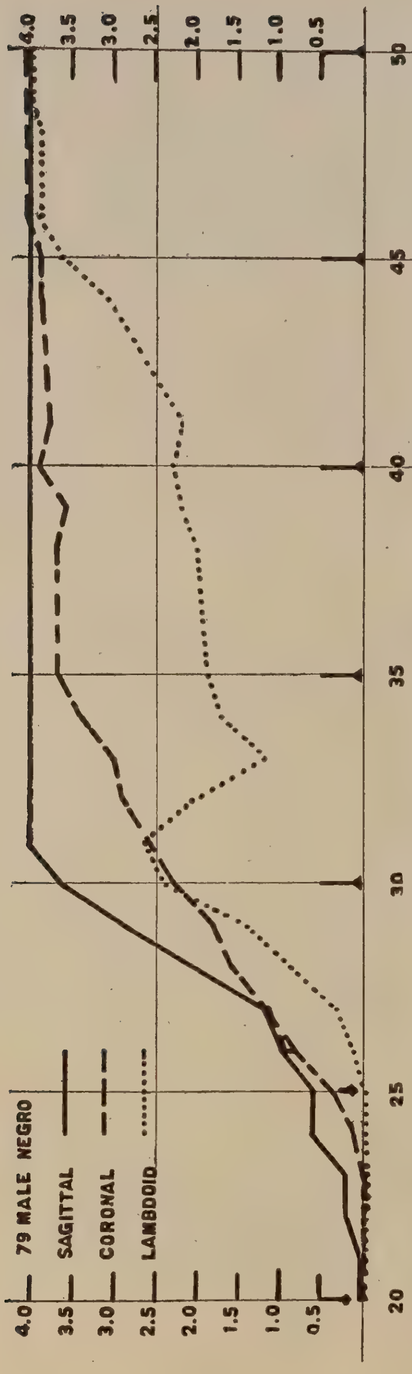

FIG. 1. Graph of closure in the vault sutures to illustrate the order of closure. All parts of the suture are averaged in this graph.

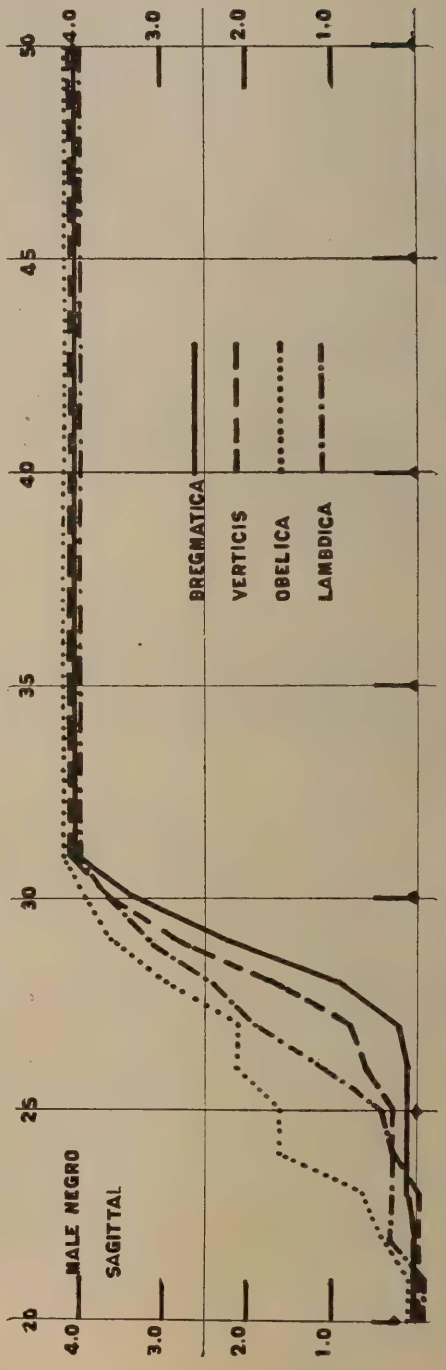

FIG. 2. Endocranial closure progress in the sagittal suture. The apparently more ordered closure in the several parts of the suture, when compared with the White graph, has probably no significance.

the skeleton but there is nothing comparable with the pronounced acceleration in cranial suture closure. It is entirely upon the state of the sutures that this skull has been eliminated from the series.

Nos. 525 and 744 of age twenty-two; 860 of age twenty-three; 764 of age twenty-five; and 190 of age twenty-six are all very beautiful examples of the anthropoid symphysial strain (4). There is complete fusion of the sagittal suture endocranially in all parts of each skull except No. 525, the bregmatic part of which is completely patent and the lambdoid only three-quarters closed.

The three specimens next to receive attention can be considered together. They are Nos. 379, age twenty-seven; 474, age twenty-eight; and 402, age twenty-nine. None shows any endocranial closure of sagittal, coronal or lambdoid sutures. All present the regressive form of symphysis and are retarded examples. How far one may associate the retardation in suture closure with the retardation of symphysial differentiation we cannot say at the moment.

There are four specimens the symphysis of which belongs to the intermediate group which I have shown to be a retrogressive and retarded form of the anthropoid strain. These are Nos. 716 and 802 of age twenty-eight; No. 563 of age twenty-nine; and No. 598 of age thirty. In No. 716 all the three sutures are completely closed. None of the others show any endocranial closure of sagittal, coronal or lambdoid sutures except No. 598 in which the second part of the left coronal is about one-quarter united. The explanation of the pronounced retardation of cranial differentiation in these specimens is not clear as yet.

The ten skulls in which there is more or less union of sutures can be arranged to exhibit their condition at a glance:—

Table I. Precocious Discards.

Age 18.	No. 693.	Sagittal 1444;	Coronal	R. 041 L. 040	; Lambdoid	R. 442 L. 430 .
	No. 695.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 444 L. 000 .
Age 22.	No. 366.	Sagittal 0444;	Coronal	R. 344 L. 344	; Lambdoid	R. 000 L. 000 .
	No. 525.	Sagittal 0443;	Coronal	R. 311 L. 121	; Lambdoid	R. 020 L. 120 .
	No. 744.	Sagittal 4444;	Coronal	R. 320 L. 320	; Lambdoid	R. 000 L. 000 .
	No. 765.	Sagittal 4444;	Coronal	R. 034 L. 000	; Lambdoid	R. 144 L. 133 .

Age 23.	No. 860.	Sagittal 4444; Coronal	R. 000 L. 000	; Lambdoid R. 444 L. 444.
Age 25.	No. 764.	Sagittal 4444; Coronal	R. 330 L. 130	; Lambdoid R. 110 L. 331.
Age 26.	No. 190.	Sagittal 4444; Coronal	R. 443 L. 444	; Lambdoid R. 443 L. 444.
Age 27.	No. 716.	Sagittal 4444; Coronal	R. 444 L. 444	; Lambdoid R. 444 L. 444.

Three skulls only remain for consideration. Of these Nos. 366 and 765 are both of age twenty-two. In the former symphysial differentiation is accelerated slightly but by no means to such an extent as is cranial suture closure: in the latter there is actual retardation of symphysial differentiation by about three years. Like certain of the male White skulls these present an interesting problem for future solution. In both specimens the sagittal is completely closed endocranially. There are however certain irregular features in the closure of other cranial sutures which lead us to suspect that aberrant influence is at work confusing the regular and normal sequence of union.

No. 695, of age eighteen, shows a curious anomaly in complete fusion of the right lambdoid suture alone.

There seems to be some delay in commencement of closure of the bregmatic part of the suture when compared with the male Whites for it does not really begin to unite until twenty-seven, a matter of five years after closure commences in the White series. The obelica and the lambdoidea are quite comparable with the White series for they commence together to unite at twenty-two. Until twenty-five they continue slowly to fuse and then take on a more rapid rate, complete union occurring at thirty-one years. The pars verticis has a fairly uniform rise once it starts but the bregmatic part lags behind until twenty-seven after which its curve shoots up to the point of complete closure more rapidly than that of any of the others.

As with the male Whites many crania occur in which there is lapsed union of the vertex and more frequently of the lambdoid parts of the sagittal suture on the endocranial surface. The characteristic heaping up of bone along the suture margins picks these out immediately.

The smoother character of the Negro curve when compared with that of the Whites is undoubtedly due to the fact that we had already got a grip upon the essential features of suture closure as a result of our study of the White series before we commenced to investigate the Negroes.

The analytic graph of sagittal closure (Fig. 2) should next be studied. The obelica begins to unite at twenty-two years. This is a year later than in the Whites but as in them, once it has started it continues rapidly to its completion which is attained at thirty-one years, two years later than in the Whites.

The lambdica also commences to close at twenty-two, shortly before the lambdica in the Whites. It progresses slowly till twenty-five and then shoots up rapidly to completion at thirty-one.

The bregmatica shows closure activity first at twenty-three, continues very slowly until twenty-seven and then rises quickly to complete union at thirty-one.

The pars verticis commences at twenty-four and follows the same pattern thereafter as the bregmatica.

In all these subdivisions of the sagittal suture there is no essential difference from the closure graph characteristic of White males. We are compelled to admit that so far as endocranial sagittal closure is concerned Negroes and Whites conform to a single pattern.

2. THE CORONAL SUTURE (Figs. 1 and 3)

Comparison of the White and Negro curves shows strikingly little difference in period or in rate of closure. This is quite compatible with our findings for the sagittal suture. The slight differences in the body of the curves probably results from the sampling. Closure in the Negro occurs in the following manner:—

Male Negro endocranial coronal closure commences at twenty-four with
- (a) an initial gradual rise to about twenty-six, quickly changing into
- (b) a fairly steep rise to 3.6 at thirty-two, after which there is
- (c) a slackening in rate but continuous progress to
- (d) complete closure at thirty-five years.

Age	Period	Number of skulls			
		Retained		Rejected	
17–23	pre-(a)	17		7	
24–31	(a)+(b)	19	22	9	13
32–34	(c)	3		4	
35–76	(d)	40		21	

Percentage of discards (a)–(c) inclusive on total of these periods............ 37.1

The analytic curves dissecting coronal closure into right and left sides and into bregmatic and complicated portions (Fig. 3) show the following features:—

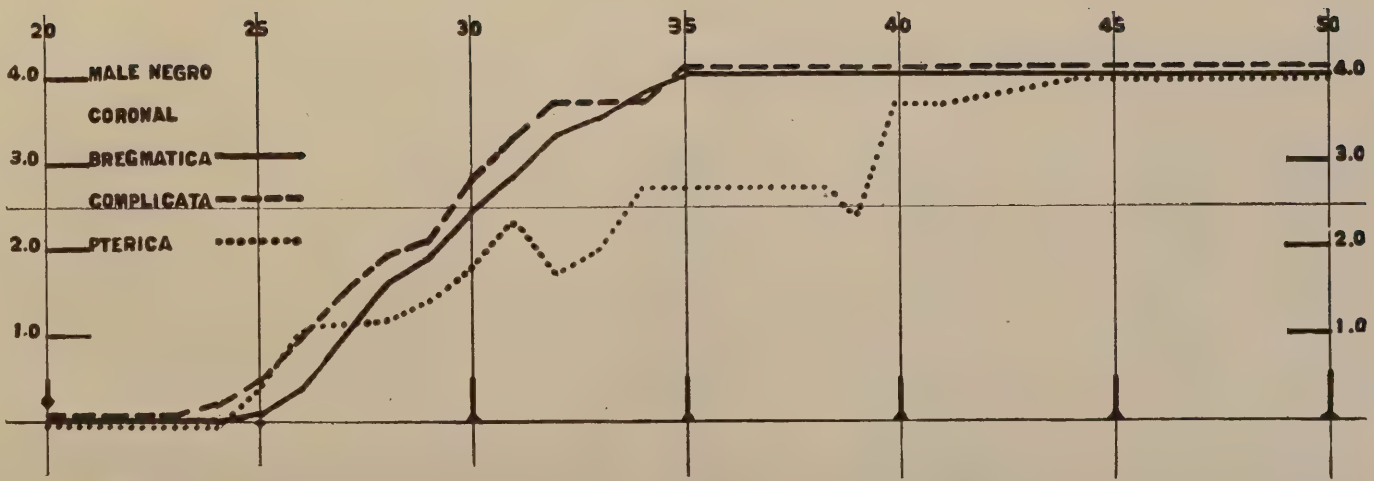

FIG. 3. Endocranial closure progress in the coronal suture. A marked distinction is present between the pterica and the other part of the suture.

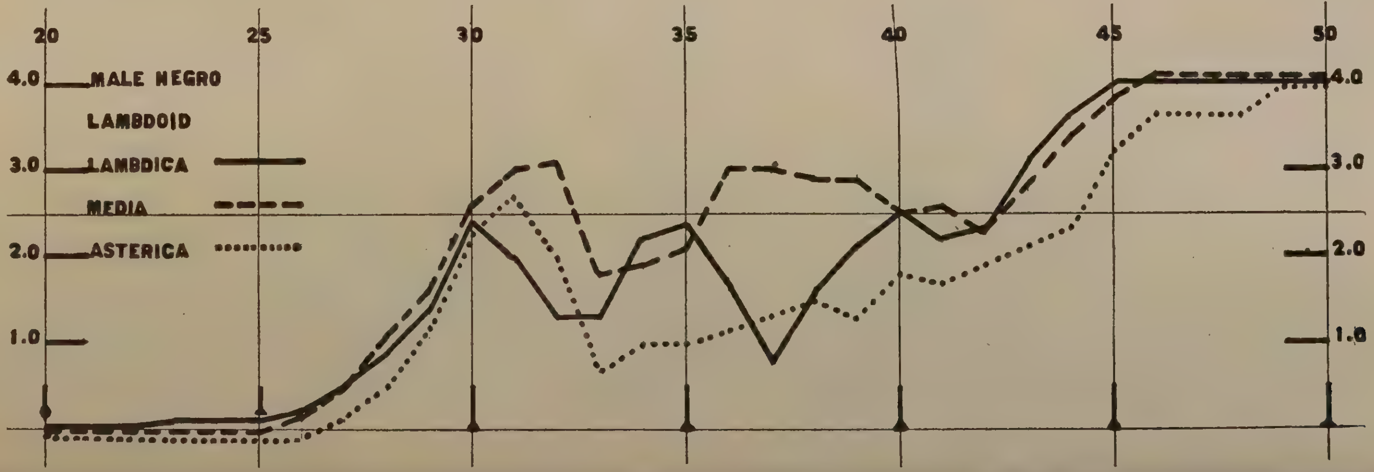

FIG. 4. Endocranial closure progress in the lambdoid suture. The great individual variability evident in this graph is characteristically Negroid.

Pars	Side	Commences to close at	Complete Closure at
Bregmatica	Right	26	35
"	Left	25	34
Complicata	Right	24	35
"	Left	22	35

The question scarcely arises as to whether there is anything significant in these differences, for it is quite obvious that they are entirely the result of random sampling.

In comparison with the corresponding results for the male White there is again no real difference. It is true that there seems to be a slight delay in commencement of closure in the bregmatic part of the Negro but this is counterbalanced by the equally slightly earlier completion of union in the complicata of the same Stock.

CLOSURE OF THE PTERIC PART OF THE CORONAL SUTURE

As in the male Whites so in the Negroes we find it advisable to separate the pteric part of the suture from the rest since it exhibits quite a different age relationship in closure. Union first makes its appearance at twenty-five, shortly after it has begun in the other parts. It continues rather rapidly until thirty-one when the retarding influence slows down the process which however continues erratically until union is completed at forty-four.

The facts then are as follows:—

Male Negro endocranial coronal closure (pteric part) commences at twenty-five years and
- (a) continues steadily until it is checked at thirty-one after which
- (b) a slower and more erratic progress is made to
- (c) complete closure at forty-four years.

Age	Period	Number of skulls			
		Retained		Rejected	
17–24	pre-(a)	22		7	
25–30	(a)	13	32	9	28
31–43	(b)	19		19	
44–76	(c)	25		6	

Percentage of discards (a+b) on total of these periods.................... 46.7

The same delaying influence observed in the male Whites at twenty-nine makes its presence felt in the Negroes at thirty-one. I do not regard this difference of two years as in any way significant; it is probably merely a result of the sampling. Nor can I consider the delay of one year in the commencement of union in the Whites as important. The fact that union is not complete in the Negroes until three years after it is attained in Whites again is shown to be devoid of real meaning by the appearance of the graph which indicates that practical completion occurs at approximately the same age in both Stocks.

3. THE LAMBDOID SUTURE (Figs. 1 and 4.)

As in the White series we shall separate the asteric portion from the lambdoid and medial parts. Less than in either the coronal suture of both Stocks or in the lambdoid suture of the Whites is this segregation actually indicated. Were the Negro lambdoid suture to be treated alone such segregation would seem quite uncalled for. It is in this fact that the real importance of the treatment finds its justification. The delaying influence upon closure which we have observed so clearly marked in the coronal suture of both Stocks and in the lambdoid of Whites is very pronounced in the Negro lambdoid suture. In this suture the retarding influence is at work not only upon the asteric part but also in pronounced degree upon the remainder of the suture. So effective may it be that there is more or less deficiency of union throughout the suture. Indeed the majority of the discards among the Negroes result from delay in lambdoid closure from which the natural inference is made that the Negro tends more and more towards complete emancipation of the lambdoid suture from any closure. The Negro lambdoid appears to be in transition, as it were, from a true suture of the vault to one of the circum-meatal group. What may be the reason for this can at present be merely the subject of conjecture: it must be discussed later in the work. For the present we note that the markedly erratic nature of lambdoid closure is quite in harmony with our general theory of emancipation. Even a casual examination of the graphs will serve to impress the facts which have led us to this interpretation.

Closure commences at twenty-three
  (a) gradually gathering speed until thirty when
  (b) a period of stagnation sets in pricked out by oscillations which lasts to the age of forty-two
  (c) when once again progress begins and continues till
  (d) complete closure is attained at forty-six.

These facts may be delineated in the following manner:—

Age	Period	Number of skulls			
		Retained		Rejected	
17–22	pre-(a)	11		6	
23–29	(a)	22		9	
30–41	(b)	21	46	20	32
42–45	(c)	3		3	
46–76	(d)	19		6	

Percentage of discards (a)—(c) inclusive on total of these periods........... 41.0

Analysis of the figures shows that union commences on both sides of the pars lambdica at twenty-three years and is complete at forty-five.

In the right pars media it begins at twenty-three and reaches completion at forty-six whereas on the left side it begins at twenty-six and is completed at forty-five.

ENDOCRANIAL CLOSURE OF THE LAMBDOID SUTURE (PARS ASTERICA)

In the asteric part closure does not make its appearance in this series until the age of twenty-seven

(a) from which it proceeds fairly rapidly until thirty-one

(b) when stagnation supervenes and continues until forty-four.

(c) At this age a new activity occurs in the progress of union lasting until forty-six,

(d) by which date closure is practically complete at 3.8.

The last stage terminates more slowly in total union at forty-nine.

Age	Period	Number of skulls Retained		Number of skulls Rejected	
17–26	pre-(a)	26		12	
27–30	(a)	9	37	4	27
31–43	(b)	19		19	
44–45	(c)	3		3	
46–48	(d)	6		1	
49–76	(e)	13		5	

Percentage of discards (a)–(d) inclusive on total of these periods........... 42.2

THE NEGRO DISCARDS

The discards of thirty years and under have already received full treatment in our discussion of the sagittal suture. The method by which we decided upon rejection has also been adequately presented in that chapter and in the paper on the White male endocranial sutures (2). Most of the discards of thirty and under have been rejected on account of precocious union. We have still to deal with another type of reject, namely that which has been discarded because of the delayed union more or less widespread among the sutures. These have been gathered together into a tabulated list and are presented below in formula in Table II (for explanation see 2, pp 331–2) so that a glance is sufficient to bring out the significant anomalies. Perhaps it was excess of zeal that eliminated No. 709, or rather, failed to restore this skull after it had been eliminated upon other counts. But with this exception there is no doubt of the anomalous condition of the crania in this list. No. 709 really remains eliminated for safety's sake.

TABLE II. RETARDED DISCARDS.

Age 27.	No. 379.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
	No. 802.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .

TABLE II. RETARDED DISCARDS. (*Cont.*)

Age 28.	No. 474.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
Age 29.	No. 402.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
	No. 563.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
Age 30.	No. 598.	Sagittal 0000;	Coronal	R. 000 L. 010	; Lambdoid	R. 000 L. 000 .
Age 33.	No. 596.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000. L. 000
	No. 638.	Sagittal 4343;	Coronal	R. 130 L. 220	; Lambdoid	R. 000 L. 000 .
	No. 705.	Sagittal 2000;	Coronal	R. 444 L. 444	; Lambdoid	R. 000 L. 440 .
	No. 709.	Sagittal 4444;	Coronal	R. 430 L. 430	; Lambdoid	R. 000 L. 000 .
Age 35.	No. 74.	Sagittal 0130;	Coronal	R. 344 L. 344	; Lambdoid	R. 043 L. 043 .
	No. 451.	Sagittal 2444;	Coronal	R. 342 L. 442	; Lambdoid	R. 000 L. 110 .
	No. 594.	Sagittal 0444;	Coronal	R. 110 L. 210	; Lambdoid	R. 000 L. 000 .
	No. 761.	Sagittal 1344;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
Age 35.	No. 906.	Sagittal 0044;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
Age 37.	No. 775.	Sagittal 0000:	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
	No. 812.	Sagittal 0000;	Coronal	R. 100 L. 110	; Lambdoid	R. 000 L. 000 .
Age 38.	No. 388.	Sagittal 0440;	Coronal	R. 000 L. 000	; Lambdoid	R. 010 L. 030 .
	No. 416.	Sagittal 4444;	Coronal	R. 342 L. 342	; Lambdoid	R. 000 L. 000 .
	No. 538.	Sagittal 0040;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
	No. 779.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .

TABLE II. RTEARDED DISCARDS. (*Cont.*)

	No. 891.	Sagittal 3420;	Coronal	R. 343 L. 343	; Lambdoid	R. 000 L. 000 .
Age 40.	No. 515.	Sagittal 0100;	Coronal	R. 342 L. 343	: Lambdoid	R. 000 L. 000 .
	No. 736.	Sagittal 1444;	Coronal	R. 444 L. 444	; Lambdoid	R. 100 L. 100 .
Age 41.	No. 835.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
Age 45.	No. 426.	Sagittal 4440;	Coronal	R. 444 L. 444	; Lambdoid	R. 000 L. 000 .
	No. 540.	Sagittal 1344;	Coronal	R. 031 L. 030	; Lambdoid	R. 000 L. 000 .
	No. 777.	Sagittal 0000;	Coronal	R. 044 L. 343	; Lambdoid	R. 000 L. 000 .
Age 48.	No. 198.	Sagittal 4441;	Coronal	R. 444 L. 444	; Lambdoid	R. 000 L. 000 .
Age 50.	No. 697.	Sagittal 0000;	Coronal	R. 000 L. 000	; Lambdoid	R. 000 L. 000 .
Age 67.	No. 522.	Sagittal 0243;	Coronal	R. 443 L. 444	; Lambdoid	R. 000 L. 000 .

THE CIRCUM-MEATAL SUTURES

1. THE MASTO-OCCIPITAL SUTURE (Fig. 5)

According to our custom the suture is subdivided into superior, middle and inferior parts. Of these the superior and middle pursue a common course and the inferior has a pattern of its own though not so distinctly different from that of the other parts as in the male Whites.

SUPERIOR AND MIDDLE PARTS

Closure in the moving average begins for both segments of what we must now regard as the upper section at the age of nineteen years but it is only between twenty-five and thirty that considerable progress is made. Indeed the rise of earlier years is probably a spurious effort (see Part II p. 27). A period of marked oscillation now sets in and is only doubtfully broken by an effort at more complete union about forty-six. After this age there is again marked oscillation but no real indication of any further closure. These facts can be briefly set forth in the following manner:—

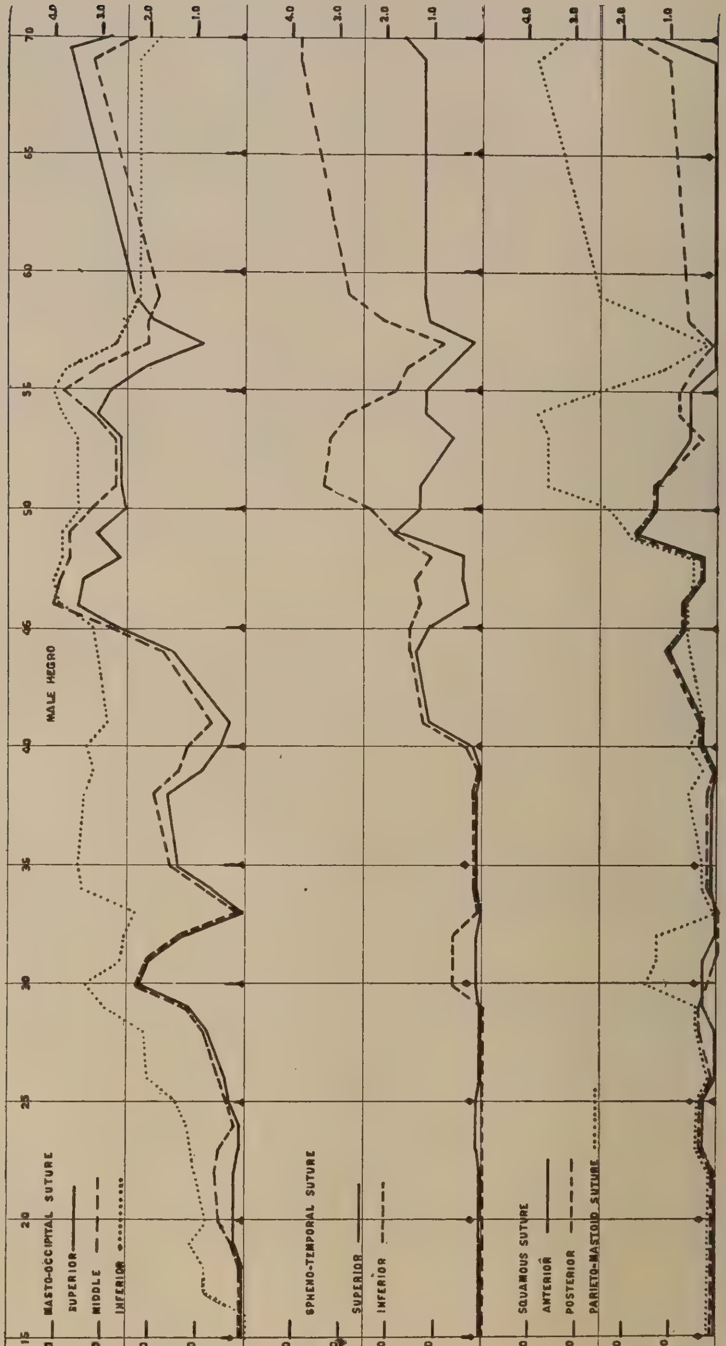

FIG. 5. Endocranial closure progress in the circum-meatal sutures. There is an erratic character in these curves which would be baffling were it not for the help of the White graph.

Age	Period	Number of skulls			
		Retained		Rejected	
17–24	pre-(a)	22		7	
25–30	(a)	13	35	9	31
31–45	(b)	22		22	
45–76	(c)	22		3	

Percentage of discards (a)–(c) inclusive to total of this period.............. 33.6

PARS INFERIOR

Closure in the inferior part is clearly defined by the moving average in the graph. It starts at seventeen years and continues fairly steadily to thirty when it reaches 3.3. Thereafter although there is a rise at forty-seven to 4.0 this must be regarded as one of the oscillations, for the graph demonstrates that there is no real progress after thirty years.

We may therefore arrange the facts thus:—

Age	Period	Number of skulls	
		Retained	Rejected
17–29	(a)	33	15
30–76	(b)	46	26

Percentage of discards (a) to total of this period.............................. 31.2

2. THE SPHENO-TEMPORAL SUTURE (Fig. 5)

As with the male Whites we divide the spheno-temporal suture into superior and inferior parts and treat these separately.

INFERIOR PART

Closure indeed makes its first appearance in the inferior part at thirty years but this is a spurious effort and there is little progress until forty when sudden activity occurs and carries the curve up to 1.2 within a year. From this time onward there is a gradual rise of the curve marked, it is true, by oscillations, until the maximum closure 3.9 is attained at sixty-nine. The really significant activity in this closure starts at forty, that during the previous decade being merely an abortive attempt due to incomplete emancipation in certain skulls. Attainment of the maximum occurs within two years of the date when the White male suture also reaches its maximum.

Age	Period	Number of skulls	
		Retained	Rejected
17–29	pre-(a)	33	15
30–39	(a)	14	17
40–68	(b)	29	9
69–76	(c)	3	0

Percentage of discards to total of this period................................ 23.7

SUPERIOR PART

Closure in the superior part of the suture appears erratically at first. There is a sporadic instance in one skull at twenty-four years which accounts for the obviously irregular rise of the curve at twenty-three.

Apart from this there is no other case until thirty and indeed the number showing any closure during the fourth decade is very small so that those can be considered spurious efforts. The curve does not again rise above 0.1 until forty when, like the curve for the inferior part, it swings upward suddenly within a year to 1.25. After this sudden rise the curve remains almost horizontal, barring oscillations, till old age.

Age	Period	Number of skulls	
		Retained	Rejected
17–29	pre-(a)	33	15
30–39	(a)	14	17
40–69	(b)	30	9
70–76	(c)	2	0

Percentage of discards (b) to total of this period........................ 23.1

The real difference between closure of the spheno-temporal suture in Negroes and in Whites is the practical emancipation of the entire suture from closure in the former during the fourth decade.

3. THE SQUAMOUS SUTURE (Fig. 5)

Closure in the squamous suture of the Negroes is even more difficult to interpret than in the male Whites and the moving average is not of great assistance. A glance at the graph indicates at once the very marked irregularity of the curve. It is only in a minority of the cases that closure actually takes place at all. Sporadic union may occur as early as twenty-three years but there is no real progress until forty when the curve for the second part rises definitely and that for the first part rises until fifty-seven when it again returns to the base line. No attention should be paid to the terminal rise on this graph for it is none other than a sporadic rise like those of earlier years. The only useful inference which may be drawn from the graph for the squamous suture is that there is in the Negro much greater emancipation from closure than in the White but at the same time there are scattered instances, occurring even in early life, in which emancipation is seen only in small degree. The real significance of sporadic closure as early as twenty-three years is to be found in the general mammalian survey of suture closure to be set forth later on. Since however there is a genuine more general partial closure in the posterior part and this does bear to age some relation which can be correlated with closure in other sutures the main facts of the graph are set forward below:

Age	Period	Number of skulls	
		Retained	Rejected
17–22	pre-(a)	11	6
23–39	(a)	36	26
40–76	(b)	32	9

Percentage of discards (b) to total of this period........................ 22.0

4. THE PARIETO-MASTOID SUTURE (Fig. 5.)

As in the squamous the parieto-mastoid suture begins to exhibit union as early as twenty-three years but this is unusual and the curve only sporadically rises until thirty-three when the period of real closure begins. Progress is slow till forty-nine when the curve rapidly rises to a peak of 3.6 at fifty-one though closure is never quite complete. In the male White series closure begins at thirty-seven years. Consequently we should be inclined to disregard absolutely the Negro rise at forty-nine, were it not that the White graph seems to indicate renewed activity at fifty-one. Taking all facts into consideration it may well be that the real rise should commence about forty years and is masked on the graph by the random sampling. We may arrange the sequence as has been done in the case of other sutures.

Age	Period	Number of skulls	
		Retained	Rejected
17–32	pre-(a)	37	16
33–48	(a)	26	23
49–76	(b)	16	2

Percentage of discards (b) to total of this period.......................... 47.0

THE ACCESSORY SUTURES

1. THE SPHENO-PARIETAL SUTURE (Fig. 6)

Closure of this suture in its course resembles very strongly the progress of union in the upper segments of the masto-occipital. Together with the features of spheno-frontal closure this resemblance with the masto-occipital becomes almost as compelling as in the male White series. Both sutures exhibit retardation after thirty years and in each there is an effort of the curve to reach complete closure in the later forties.

The facts are then that

Closure commences at twenty-three with

(a) a gradual rise to 2.7 at thirty after which

(b) a period of stagnation marked by oscillations follows, ending with

(c) a sudden rise to complete union at forty-nine.

Age	Period	Number of skulls			
		Retained		Rejected	
17–22	pre-(a)	11		6	
23–29	(a)	22	52	29	33
30–48	(b)	30		4	
49–76	(c)	16		2	

Percentage of discards (a+b) to total of this period........................ 38.8

2. THE SPHENO-FRONTAL SUTURE (Fig. 6)

Again as in male Whites one cannot help noting the striking similarity in course of closure between this suture, of which the two parts pursue

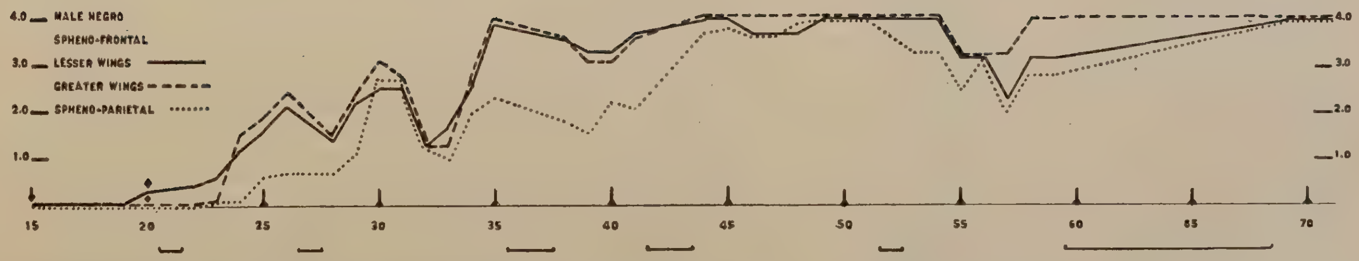

FIG. 6. Endocranial closure progress in the accessory sutures. The under-lines indicate sites where there were no skulls represented in the original series of seventy-nine. This defect no longer exists.

a strictly parallel course, and the inferior masto-occipital. Both commence at a rather unusually early age, show some slowing down about thirty years and both present an irregular course thereafter with some indication of a possible complete closure in the mid-forties.

Actually the facts for the spheno-frontal are these. Union commences at twenty years and pursues a fairly steady course to 2.8 at thirty when the progress becomes markedly erratic. The complete closure which the graph shows at thirty-five must be understood to be simply a sporadic leap for nothing like steady maintenance of union takes place till forty-four and even then the curve does not retain absolutely its high position. Analysis of the graph shows that the suture in the lesser wings alone begins to unite at twenty, that for the greater wings following suit only at twenty-three, although once the latter has started, its progress parallels very closely the closure of the former. The dip on the graph occurring after fifty-four is a constant feature of this sample and undoubtedly should be considered an irregularity of the particular series.

We may then summarize in the following manner:—

(a) Closure commences at twenty years for the lesser wings, followed at twenty-three by the greater wings and progresses steadily till thirty when there occurs

(b) a slowing down of progress with a markedly erratic course until forty-four when

(c) complete union is attained.

Age	Period	Number of skulls			
		Retained		Rejected	
17–19	pre-(a)	5		2	
20–29	(a)	28	49	13	33
30–43	(b)	21		20	
44–76	(c)	25		6	

Percentage of discards (a+b) to total of this period........................ 40.2

COMPARISON OF WHITE AND NEGRO CLOSURE

For convenience we have submitted the essential features of Negro closure in the form of a table (Table III) and have reproduced the male White endocranial table (Table IV) for comparison. In the former we have adopted the same order as that used in the White series so that differences between the two tables will be the more striking. The first glance indicates that there is no very fundamental difference and we must therefore assume that Race, or as we should prefer to term it Stock, has no real relationship to pattern of endocranial closure. This conclusion is of course restricted by the evidence to White and Negro Stocks only. The large number of Negro rejects must however raise doubt as to whether our Negro graph is simply the result of our sub-

Table III. Cranial Sutures—Male Negro Endocranial Closure.

Suture	Commencement and course	Termination (or peak)	
Sagittal	22	31	slow to 26 complete
Spheno-frontal lesser w.	20	44	complete
Spheno-frontal greater w.	23	44	complete
Coronal 1 and 2	24	38	slows at 32 at 3.6
Coronal 3	25	44	slows at 31 at 2.3
Lambdoid 1 and 2	23	46	slows at 30 at 2.5 slow to 26
Lambdoid 3	27	46	slows at 31 at 2.7
Masto-occipital 3	17	30 at 3.3	no further progress
Speno-parietal	23	49	slows at 30 at 2.7
Spheno-temporal 2	40	51 at 3.3	oscillations thereafter
Spheno-temporal 1	40	41 at 1.2	oscillations thereafter
Masto-occipital 1 and 2	25	46 at 3.5	no further progress
Parieto-mastoid	33	51 at 3.6	oscillations thereafter
Squamous posterior	40	49 at 1.7	oscillations thereafter
Squamous anterior	40	49 at 1.7	oscillations thereafter

Table IV. Cranial Sutures—Male White Endocranial Closure.

Sagittal	22	slow to 26	35	slows at 31 at 3.9
Spheno-frontal lesser w.	22		64	slows at 30 at 3.0 final burst of activity
Spheno-frontal greater w	22		65	slows at 30 at 3.0 final burst of activity
Coronal 1 and 2	24		38	slows at 29 at 3.4
Coronal 3	26	rapid to ca 30	41	slows at 29 at 2.1
Lambdoid 1 and 2	26		42	slows at 31 at 3.4
Lambdoid 3	26		47	slows at 30 at 2.2
Masto-occipital 3	26		72	32–48 at 3.2 slow progress thereafter
Spheno-parietal	29	slow at once	65	29–46 at 3.0 slow progress thereafter
Spheno-temporal 2	30		67 at 3.9	gradual progress
Spheno-temporal 1	31		64 at 2.4	31–62 at 0.5 burst of activity at 63
Masto-occipital 1 and 2	30		81	32–45 at 1.25 activity between 46 and 64 final burst of activity
Parieto-mastoid	37		81	almost inactive till 50 slow progress thereafter
Squamous posterior	37	almost inactive till 62	81	burst of activity at 63 burst of activity at 79
Squamous anterior	37		81 at 3.2	burst of activity at 63 burst of activity at 79

conscious prejudice in favor of the White type. We have had this pitfall constantly in mind and are convinced that we have not fallen into it. The method of rejection has been exactly the same for both series and has not been based primarily upon suture closure at all except where gross anomalies were obvious.

Apart however from the method of rejection there are intrinsic characters of the series itself which indicate that we have correctly interpreted our facts. These have to do with the variability, with the direction of that variability and with the site of maximum variability. We have brought together, as Table V, the number of rejects in both series and their percentages on the total number of the respective series. The total number of rejects in the Negro group is not far short of three times the number among the male Whites. In a general way these discards may be subdivided into precocious and retarded groups. It is true that we sometimes meet with a specimen displaying precocious closure in certain sutures and retarded union in others: we have grouped the crania according to the prevailing tendency. Retarded examples are nine times as frequent as precocious specimens in the White series: among the Negroes they are three times as numerous. Such variability as occurs in Whites tends more to retardation of closure than in Negroes but this does not mean a greater relative tendency towards retardation in Whites than in Negroes (see pp. 56,62). It is apparent that, had we made an error in estimating the relative position of the modal type in Negroes, the Negro rejects should tail off in one direction further than the White discards. Now it so happens that the tailing off is in the direction of precocity and as we have already listed the discards one can readily examine the condition of the sutures of the precocious group. These are ten in number and include practically all the rejects from eighteen to twenty-seven years inclusive. We believe that a few minutes' study of Table I will convince the reader of the justice of our exclusion of these specimens. If they are discarded, the graph of the period of election for suture closure must necessarily take the form which we have given it. We have not thought it worth while to list the condition of the circummeatal and accessory sutures in these specimens. In the former group there is no union at all in the spheno-temporal suture; there is closure in part in the right squamous of No. 693, in the right parieto-mastoid of Nos. 693 and 695 and in both parieto-mastoids of No. 860. The entire masto-occipital is united on both sides of Nos. 695, 765, 860 and 190; the

Table V. Percentages of Discards.

	White male	Negro male
Number in series	307	120
Total number of discards	40	41
Percentage	13.0	34.2
Number of precocious discards	4	10
Percentage	1.3	8.4
Number of retarded discards	36	31
Percentage	11.7	25.8

right suture alone is united in No. 693 and the third part only on both sides of No. 716. Except No. 716 which is normal in its circum-meatal union all these are anomalous in circum-meatal closure as well as in the vault. The variability and direction of this variability in the Negro serve simply to confirm the modal type of closure which we have described.

The focus of variability in the Negro as in the White is the lambdoid suture. Other sutures are involved in some instances but it is the lambdoid which is most frequently and thoroughly implicated and this in spite of our elimination of lapsed union from the series of variables. This is quite in accord with the fact that in modal closure the coronal attains and holds a slight precedence over the lambdoid, a fact, be it noted, as characteristic of the Negro as of the White, contrary to established opinion. In human suture closure there is almost complete emancipation in certain of the circum-meatal sutures and with this emancipation there is a marked tendency to include the lambdoid. We cannot avoid the impression that the human cranium is expanding over the regions which include the squamous and lambdoid sutures in order to accomodate the enlarging brain. It must not be inferred from this that we imply any tendency in the human cranium to become more dolichocephalic. It is not possible to present here the evidence obtained in this laboratory on the problem of cranial development but we may state quite categorically that expansion in the lambdoid region does not involve any specific tendency towards either dolichocephaly or brachycephaly.

The greater irregularity of the graphs in spite of more careful and experienced combing, like the other evidences of variability already discussed, is characteristic of the Negro. We need not be at all surprised at this. Some time ago it was decided that some check observations must be carried out upon the apparently greater bodily variability in Negroes. For the check to be effective a part of the body other than the skull had to be chosen. Dr. T. A. Willis therefore undertook an investigation of the thoracico-lumbar spinal column. The results of this research have been already published (5) and fully bear out the theory of a greater variability in the Negro. In the vertebral column also these variations are about a mean common to White and Negro; they do not produce a specially skewed Negro curve.

Minor variabilities, not great enough to cause exclusion of the skull from our series, but still large enough to produce marked irregularity in the graphs, are also more frequent in the Negro series. In the vault sutures they are relatively infrequent in the sagittal but are apparent in the coronal and lambdoid and are oftenest found in the circum-meatal and accessory sutures. So far as later progress in union is concerned there is no salient distinction between White and Negro series but in commencement the Negro spheno-temporal lags behind the White by about a decade whereas the masto-occipital and spheno-parietal precede by several years.

Comparison of the several Negro graphs reveals nothing specially characteristic or new in suture closure. The spheno-parietal, the first and second parts of the masto-occipital and the third part of the lambdoid strongly resemble each other and so do the third part of the masto-occipital and the spheno-frontal.

Much as existing prejudices and the statements of earlier writers have predisposed us to seek for some characteristic difference in Negro suture closure we have been quite unable to find any such condition.

According to Gratiolet (1) the sutures in White Stock ossify in a tardy manner compared with progress in Negro Stock. Comparison of tables III and IV shows indications of relatively accelerated progress in the Negro in the spheno-frontal and spheno-parietal sutures only and of retardation in the Negro in the entire circum-meatal group. It is possible that one should not emphasize this difference but certainly the occurrence of the difference indicates that there is no tendency on the part of the Negro sutures to earlier completion of ossification.

One notes with surprise bordering on amazement the extent to which prejudice and preconception have in the past called forth statements which scanty knowledge was unable to refute. In the article referred to Gratiolet continues:

"Has the long persistence of the patent sutures in the White race any relation to the almost indefinable perfection (perfectibilité) of their intelligence? Does not this continuance of an infantile condition seem to indicate that the brain may, in these perfect men, remain capable of slow growth? Perhaps it is this which makes the perpetual youthfulness of spirit in the greatest thinkers seem able to defy old age and death. But in idiots and in brutish races the cranium closes itself on the brain like a prison. It is no longer a temple divine, to use Malpighi's expression, but a sort of helmet capable of resisting heavy blows."

LAPSED UNION IN NEGROES AND WHITES

The fact that we have been unable to find any significant difference between Whites and Negroes in date or progress of suture closure has caused us to doubt gravely the value of such earlier work as that of Gratiolet but before finally condemning previous writings on this point we desire to present our evidence upon lapsed union for it is apparent that if this phenomenon occurs more frequently in White Stock it may have misled those with less opportunity than we have had for quantitative study.

The following table (VI) sums up our information regarding lapsed union. It is apparent from these figures that, considering the numbers involved, there is no significant difference in the groupings. Such evidence as emerges from the table is quite contradictory to established views. Gratiolet speaks of the order of closure in White Stock as sagittal, lambdoid, coronal, and in Negro Stock as sagittal, coronal, lambdoid. Lapsed union could not have misled him, but indeed it is very doubtful if he had the opportunity to examine the interior of many crania. We must therefore conclude that the large number of Negro crania which show retardation in lambdoid closure, skulls which we are compelled to regard as abmodal (see p. 56), is probably the cause of this misleading statement by Gratiolet and others. Some change seems even now to be taking place in this region of the Negro cranium. We have expressed it earlier in this paper (p. 56) by suggesting that the Negro lambdoid suture appears to be taking on the characters of the circum-meatal group.

TABLE VI. LAPSED UNION—ENDOCRANIAL

	Male White	Male Negro
Total skulls	307	120
Skulls showing lapsed union	91	23
Percentage	29.6	22.5
Number of cases		
Sagittal	48	15
Percentage	52.7	65.2
Bregmatica	12	6
Verticis	35	8
Obelica	6	7
Lambdica	21	6
Coronal	5	4
Percentage	5.5	17.4
Bregmatica	4	3
Complicata	0	1
Pterica	1	0
Lambdoid	67	12
Percentage	73.6	52.2
Lambdica	65	12
Media	2	0
Asterica	3	0

SUMMARY

1. Endocranial suture closure in the Negro presents no fundamental or essential difference in pattern of graph or in age relationship from closure in Whites.

2. Individual variability in minor details is much greater in the Negro.

3. Individual variability in major details, resulting in rejection of the cranium as anomalous in suture closure, is more frequent in the Negro but this variability is on both sides of the mean common to Negro and White Stocks.

4. There is a similar tendency towards lapsed union as in Whites.

5. As in the Whites the coronal suture attains and holds a slight precedence over the lambdoid in closure.

6. So far as our evidence goes there is one modal type of human suture closure unaffected by Race or Stock and human emancipation from the mammalian type of closure is focussed upon the squamous and its subsidiary sutures and upon the lambdoid.

7. There is nothing in our results to indicate any relation between cephalic index and the type, site, or degree of emancipation.

8. Many negro skulls have been rejected as abmodal because of delay in closure of the lambdoid suture. It appears that some change is even now taking place in this region of the Negro cranium.

REFERENCES

1. Gratiolet (P.)—1856. Mémoire sur le développement de la forme du crâne de l'homme, et sur quelques variations qu'on observe dans la marche de l'ossification de ses sutures. *C. R. Acad. Sci.*, XLIII, 428–431.
2. Todd (T. W.) and Lyon (D. W.)—1924. Endocranial suture closure, Part I. Adult males of White Stock. *Am. J. Phys. Anthrop.*, VII, 325–384.
3. Todd (T. W.) and Lyon (D. W.)—1925. Suture Closure, Part II. Ectocranial closure in adult males of White Stock. *Am. J. Phys. Anthrop.*, VIII, 23–45.
4. Todd (T. W.)—1923. Age changes in the pubic symphysis. VII. The anthropoid strain in human pubic symphyses of the third decade. *Journ. Anat.*, LVII. 274–294.
5. Willis (T. A.)—1923. The thoracico-lumbar column in White and Negro Stocks. *Anat. Rec.*, XXVI, 31–40.

NOTES ON PHYSICAL ANTHROPOLOGY OF AUSTRALIAN ABORIGINES AND BLACK-WHITE HYBRIDS

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INTRODUCTION

In September 1914, after the meetings of the British Association in Australia, I was given transportation by the Government of New South Wales, enabling me to go to the government reservation for aborigines at Brewarrina on the Burke division of the State railroad. This reservation is on the Barwon fork of the Darling River, about 60 miles south of the Queensland boundary. The purpose of the visit was to observe near by a number of individuals of the fast disappearing race.

While at Brewarrina, during about six days, I enjoyed the hospitality of Mr. and Mrs. Arnold in charge of the Station; and it was through Mr. Arnold's tact and good judgment that I was enabled to see as many of the inhabitants of the Station as time permitted and to make some simple measurements upon them.

METHODS

As special anthropometric apparatus was not available use was made of tapes—one graduated metrically and the other in English units—and a pair of hinged calipers such as is used in machine work. The measurements were made on the porch of the superintendent's residence. One corner served for span measurements. Statures were taken without shoes; the subject stood against a portion of vertical "trim" of the house; the level of the vertex was found by means of a magazine whose back was placed tangentially to the vertex, and the level marked on the wall. The chest girth was taken in contact with the skin with the English tape, and then the measurements transmuted into metric ones; but pelvic girths were taken with the English tape over clothing and 3 cm. subtracted from the measurement. Shoulder breadth was taken by the tape between outer faces of the deltoid muscles. Girths of the extremities were taken by the tape on skin; head and face dimensions by the calipers. Skin color was measured by the Bradley color top; oral temperature by a clinical thermometer, with the subject sitting, at rest.

ACKNOWLEDGMENTS

Acknowledgment for courtesies received are due to the government of New South Wales who made arrangements for the visit to Brewar-

rina and to Mr. and Mrs. Arnold for hospitalities received at their house. It was as a guest of the Commonwealth of Australia that my trip to Australia was made financially possible. On return to America the new conditions presented by the World War were partly responsible for the long delay in preparing the measurements for publication. In the reduction of the data I have been assisted by Miss Anne W. March.

RESULTS

The measurements as taken are reproduced in Tables A and B, at the end of the paper.

STATURE

Table 1 gives in the first line the average stature of the 6 male and 7 female full bloods.[1] The 4 following lines give comparative averages obtained by other authors. These are followed by some comparative data from South Western New Guinea, which show that there are tribes in these districts of about the same stature as the average of those found at Brewarrina. On the other hand the Papuans of the center and north of New Guinea are markedly shorter. The turu natives in German East Africa, like many tribes about the Great Lakes, resemble the Australians in many ways, including stature.

Table 1. Statures, Average, Males and Females, Full Blood.

Locality or tribe	Number and sex	Average Statures Male	Average Statures Female	Reference
		cm.	*cm.*	
Brewarrina mission,	6♂, 7♀	167.0	152.0	C. B. D. in 1914.
Brewarrina mission,	3♂, 3♀	167.5	156	Fraser, 1892.
Clarence River, N. S. W.,	7♂, 3♀	167.1	153.1	Pöch, 1915.
Central South Australia,	20♂,10♀	166.4	156	Spencer and Gillen, 1899.
Central Australia,	23♂,17♀	171.5	159	Spencer and Gillen, 1904.
Queensland,	4♂, 2♀	163.0	155.5	Houzé et Jacques, 1884.
Brit. New Guinea, Bensbach River,		169.1	—	Seligman and Strong, 1906.
Brit. New Guinea, Meraŭke,	46♂,16♀	167.2	156.7	Koch, 1908.
Brit. New Guinea, Kiwai,	19♂ —	165.6	—	Chalmers, 1897.
Brit. New Guinea, Maipua,	6♂ —	163.6	—	Chalmers, 1897.
German East Africa, North East Section, Turu,	6♂, 7♀	166.2	149.8	Ried, 1915.

SITTING HEIGHT

Table 2 gives in the first line the average sitting height of my subjects; also, for comparison, the averages obtained by other students of Australian aborigines, together with comparative data from Chinese and Scotch in the United States. Both in average absolute and relative sitting height the Australian aborigines are far inferior to the other races cited, and indeed, to all other known races. They have the longest legs of any people of the world; and the Southern Papuans approach them closely.

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[1] The females measured by me included several old women whose stature had probably undergone a shrinkage of 2 to 4 centimeters on account of age.

TABLE 2. SITTING HEIGHT, AVERAGE, ABSOLUTE AND RELATIVE.

Locality or Race	Number and sex	Average Sit. Ht. Male cm.	Average Sit. Ht. Female cm.	Percent Excess Male cm.	Average Rel. Sit. Ht., per cent Male	Average Rel. Sit. Ht., per cent Female	References
Brewarrina mission	6 ♂, 7 ♀	83.1	75.2	10.5	*49.8*	*49.4*	C. B. D. in 1914.
Clarence River, N. S. W	5 ♂, 2 ♀	83.9	74.8	10.8	*50.3*	*48.6*	Pöch, 1915.
Central South Australia	19 ♂, 10 ♀	78.0	76.1	2.5	*46.8*	*48.5*	Spencer and Gillen, 1899.
Central Australia	23 ♂, 17 ♀	81.7	75.9	7.6	*47.7*	*47.7*	Spencer and Gillen, 1904.
New Guinea, Meraŭke	24 ♂, 10 ♀	80.7	75.7	6.6	*48.2*	*48.8*	Koch, 1908.
Chinese, U. S. A	22 ♂, —	89.1	—	—	*52.0*	—	Davenport and Love, 1921.
Scotch, U. S. A	2074 ♂, —	90.7	—	—	*53.1*	—	Davenport and Love, 1921.

SPAN OF ARMS

Table 3 gives averages for the Australian aborigines measured by me, and some comparative data. The relative span, though high, is not so extreme as the leg length. Some Baltic peoples and some African tribes have a relative span exceeding that of these Australians. On the other hand, among most Europeans and Asiatics it is less.

Relatively long legs is a characteristic of 12-year old European children, while at this age relative span is more mediocre in such children. The hypothesis suggests itself that in their physical proportions the Australian aborigines retain to the adult stage a younger ontogenetic stage than any other race.

HEAD PROPORTIONS

Table 4 gives the average length, breadth and cephalic index of the Brewarrina subjects and, for comparison, averages found by others for Australian aborigines, some Southern Papuans and Negroes.

The head length of these Australians is about the greatest of any people in the world. The Maipua of New Guinea, measured by Chambers, have about the same length; the Turu have a slightly shorter head. I may add that the average in my series was increased by the exceptionally long head (20.3 cm.) of Mary Marshall and her father, Clyde Marshall (21.5 cm.).

The *head breadth*, on the other hand, is, on the average, less than that of most races of men. The Maipua of New Guinea were found by Chambers to have even narrower heads. The cephalic index of the Australians is very low. They are among the most dolichocephalic of peoples. Though many African negro tribes are dolichocephalic few reach the extreme of the Australian aborigines. The Maipua of New Guinea, by virtue of their narrow heads, are also among the most dolichocephalic of races.

Among the extremes from Australia may be mentioned a male, measured by Spencer, who had an index of 67 and another with an index of 83.

TABLE 3. SPAN OF ARMS, ABSOLUTE AND RELATIVE.

Locality or Race	Number and sex	Avg. Span Male	Female
		cm.	cm.
Brewarrina mission	6 ♂, 6 ♀*	175.0	159.8
Clarence River, N. S. W	6 ♂, 3 ♀	176.0	163.9
Central South Australia	20 ♂, 10 ♀	172.2	161.0
Central Australia	23 ♂, 17 ♀	181.5	168.9
New Guinea, Meraŭke	46 ♂, 16 ♀	178.0	164.2
New Guinea, Kiwai	19 ♂, —	176.1	—
German East Africa, N. E. Sect., Turu	6 ♂, 7 ♀	176.1	156.6
Chinese, U. S. A	23 ♂, —	176.4	—
Scotch, U. S. A	2066 ♂, —	175.6	—

Locality or Race	Relative Span p.c. Male	Female	References
Brewarrina mission	*105.1*	*104.5*	C. B. D. in 1914.
Clarence River, N. S. W	*105.1*	*106.3*	Pöch, 1915.
Central South Australia	*103.5*	*102.7*	Spencer and Gillen, 1899
Central Australia	*105.9*	*106.1*	Spencer and Gillen, 1904.
New Guinea, Meraŭke	*106.5*	*104.8*	Koch, 1908.
New Guinea, Kiwai	*106.3*	—	Chalmers, 1897.
German East Africa, N. E. Sect., Turu	*105.9*	*105.1*	Ried, 1915.
Chinese, U. S. A	*103.1*	—	Davenport and Love, 1921.
Scotch, U. S. A	*101.8*	—	Davenport and Love, 1921.

*Omitting Mary Travers, 90 years old.

TABLE 4. HEAD: LENGTH, BREADTH, AND CEPHALIC INDEX.

Locality or Race	Number and sex	Average Length Male	Female	Average Breadth Male	Female
		cm.	cm.	cm.	
Brewarrina mission	6 ♂, 7 ♀	19.65	19.1	14.67	13.89
Clarence River, N. S. W	7 ♂, 3 ♀	19.7	18.5	14.3	14.0
Central South Australia	20 ♂, 10 ♀	19.–	18.07	14.2	13.7
Central Australia	23 ♂, 17 ♀	19.2	18.4	13.8	13.2
Queensland	4 ♂, 2 ♀	18.95	18.35	13.42	13.4
New Guinea, Meraŭke	46 ♂, 16 ♀	18.8	18.–	14.1	13.5
New Guinea, Kiwai	19 ♂, —	17.6	—	14.5	—
New Guinea, Maipua	6 ♂, —	19.3	—	13.5	—
German East Africa, N. E. Sect., Turu	6 ♂, 7 ♀	18.76	18.2	13.96	13.8

Locality or Race	Lgth-Brth Ind. Male	Lgth-Brth Ind. Female	References
Brewarrina mission	74.7	72.6	C. B. D. in 1914.
Clarence River, N. S. W.	72.6	75.9	Pöch, 1915.
Central South Australia	74.8	75.6	Spencer and Gillen, 1899.
Central Australia	72.4	71.8	Spencer and Gillen, 1904.
Queensland	70.8	73.0	Houzé et Jacques, 1884.
New Guinea, Meraŭke	75.2	75.6	Koch, 1908.
New Guinea, Kiwai	83.–	—	Chalmers, 1897.
New Guinea, Maipua	70.–	—	Chalmers, 1897.
German East Africa, N. E. Sect., Turu	74.4	75.8	Ried, 1915.

The extreme dolichocephaly of the native Australians has long been recognized as one of their outstanding characteristics. It allies them, first of all, with the southern Papuans and also with tribes of India and central Africa. Such heads are rarely found in living Europeans. They were, however, common in prehistoric times in northern Europe and also in certain neolithic stations, such as Baumes-Chaudes and l'Homme-Morte, of France (Mayet, 1913) where skulls are found with an average index of about 72. Thus the head proportions of the Australian aborigines are more like those of Neanderthal man than of modern Europeans.

FACE LENGTH

The morphological face length (Martin's [1914] No. 18b) was measured by me from gnathion to glabella. The average for the full blooded males was 12.3 cm.; for the females 11.5 cm. Subtracting 10 mm. to reduce approximately to the gnathion-nasion distance we get ♂. 11.3, ♀. 10.5, which compares closely with Spencer and Gillen's (1904) dimentions of ♂. 11.5, ♀. 10.5. Koch found an average of 11.7 cm. for males of Meraŭke, New Guinea, and Ried of 11.28 cm. for males of the Turu tribe in German East Africa. The face of the Australians is absolutely short as compared with that of Caucasians and Mongolians (12.0 to 12.7 cm.)

TABLE 5. GIRTH OF CHEST, AT REST.

Locality or Race	Number and sex	Avg. Chest gir. Male	Avg. Chest gir. Female
Brewarrina mission	6♂, 5♀	86.7	80.–
Central South Australia	20♂, 10♀	90.3	82.2
Central Australia	23♂, —♀	88.7	—
Queensland	4♂, 2♀	84.4	77.5
New Guinea, Meraŭke	10♂, 10♀	86.5	82.4
Scotch, U. S. A.	2067♂, —♀	88.6	—

Locality or Race	Rel. Chest Gir. p.c. Male	Rel. Chest Gir. p.c. Female	References
Brewarrina mission	52.9	52.4	C. B. D. in 1914.
Central South Australia	51.7	52.4	Spencer and Gillen, 1899.
Central Australia	51.8	—	Spencer and Gillen, 1904
Queensland	51.7	49.9	Houzé et Jacques.
New Guinea, Meraŭke	52.2	52.9	Koch, 1908.
Scotch, U. S. A.	51.3	—	Davenport and Love, 1921.

GIRTH OF CHEST, AT REST

Table 5 gives the average absolute as well as relative chest girth at rest, for the Brewarrina full bloods. These measurements were made under the axillae in contact with the skin. Measurements were also taken at full inspiration. The average increase on inflation is for males 5.7 cm., for females 2.4 cm. The small chest girth obtained by Houzé and Jacques is probably associated with the ill health of the subjects. The relative chest girth of Australian aborigines occupies an intermediate position among the races of man. Especially the African negroes are characterized by small relative chest girth, in contrast with the short legged Amerindians and certain tribes of Mongolians which have a large relative chest girth.

SHOULDER BREADTH

This was taken between the outer surfaces of the deltoid muscles. Among the full bloods there was found an average for the males of 39.1 cm. and for the females of 36.3 cm. In contrast with the 391 mm. of Australians is the 42.9 cm. shoulder breadth of negro and mulatto soldiers of the United States army (Davenport and Love, 1921). The relative shoulder breadth is for male Australians 23.4 and for females 23.8 per cent. A relative *biacromial* breadth of about 20.5 p. c. has been found by Spencer and Gillen (1899, 1904) and others. The Australian aborigines are thus even more extremely narrow in shoulder breadth than in chest girth, and show themselves to be the narrowest shouldered of the main races of mankind, excepting certain groups of African negroes.

PELVIC GIRTH

This is an unsatisfactory dimension largely because it had to be taken over the clothing, which made it difficult to measure always the corresponding part of the body and which added to the absolute dimension. The latter error is, in part, reduced by subtracting always 3 cm., from the measurement actually obtained. The measurement was made on the pelvic crest. The girth as found in the 6 men averages 91.6 cm., and in 3 women 90 cm. In view of the well known fact that pelvic girth is generally greater in women than men this result is surprising. But it is supported by the observations of Baldwin and Gillen who found the distance between iliac crests to be 26.7 cm. in males and only 25.4 cm. in females. Apparently in Australians the pelvis is smaller in the female than in the male.

MAXIMUM GIRTH: UPPER ARM

This was taken next to the skin, with the arm hanging and also flexed. For 3 men the average girth of hanging arm is 28.7., for 4 women 24.5 cm. This is somewhat below the average of 29.3 to 30 given for college men in the United States by Seaver (1909).

TABLE 6. MAXIMUM GIRTH OF CALF.

Locality or Race	Number and sex	Avg. Calf Gir. mm. Male	Avg. Calf Gir. mm. Female
		cm.	*cm.*
Brewarrina mission	6♂, 7♀	32.7	27.4
Central South Australia	20♂,10♀	31.2	29.8
Central Australia	23♂,17♀	31.1	28.5
Queensland	4♂, 2♀	27.2	27.5
New Guinea, Meraŭke	32♂,16♀	35.2	32.5
Scotch, U. S. A.	2079♂,—	34.0	—

	Rel. Calf Gir. p.c. Male	Rel. Calf Gir. p.c. Female	
Brewarrina mission	*19.6*	*18.0*	C. B. D. in 1914.
Central South Australia	*18.8*	*19.0*	Spencer and Gillen, 1899.
Central Australia	*18.1*	*17.9*	Spencer and Gillen, 1904.
Queensland	*16.7*	*17.8*	Houzé et Jacques.
New Guinea, Meraŭke	*21.0*	*20.7*	Koch, 1908, p. 10.
Scotch, U. S. A.	*19.7*	—	Davenport and Love, 1921.

MAXIMUM GIRTH OF CALF

Table 6 gives the maximum girth of calf of the leg for the full bloods at Brewarrina, with the usual comparative data. The average relative calf girth among my males is unduly raised by one powerfully built, but short, man (Clyde Marshall). In general, the Australian aborigines possess, together with some African negro tribes, the slenderest of legs. This slenderness is associated with the great length of leg, since the longer the gastronemius and soleus muscles of the calf the smaller the circumference of their bellies, upon which the girth of calf chiefly depends.

SKIN COLOR

The skin color was measured with the Milton Bradley color top on the lateral upper arm in the same place as that measured by Miss Danielson in her examinations of negro-white crosses in Jamaica and Bermuda (Davenport, 1913). In full blooded negroes Miss Danielson found the following distribution of N+R (black+red) pigment, as measured by the color top. Below are placed our Australian measurements on "full bloods."

Percent N+R	70–74	75–79	80–84	85–89	90–94	95–99	Total
Negroes: Jamaica, and Bermuda	2	2	3	8	2	1	18
Brewarrina Australians			1	4	8		13

From this table it appears that the Australian aboriginals of Brewarrina were darker than the negroes of Jamaica and Bermuda. However, 4 of the Bermuda full blacks measured by Miss Danielson have a larger proportion of black than any Australians measured by me. On the other hand, the red in these same negroes was less than in any of the Australians; so that, on the whole, the Australian "black" fellows of New South Wales are darker than the average full blooded negroes of Bermuda.

There is considerable variability in color. The skin color of Jennie Sargent contains only 48 per cent black. She was recognized as belonging to a different tribe from the others—she is one of the "Bogan blacks", I was told. (The Bogan River lies south of Brewarrina.) This variation in color might be regarded as due to an unknown, or unadmitted, admixture of white blood within the last 3 generations. But this is opposed to the testimony of the woman; nor is it necessary to assume any such thing, for the earliest explorers recognized two types of color among the Australians—one approaching a copper color and the other black (Mathew, 1899, 11, quoting Jardine). The Rev. George Taplin (in his "Native Tribes of South Australia," 129) states that in the different tribes of Australians "there is a remarkable difference in color and cast of features; some natives have light complexions, straight hair and a Malay countenance, while others have curly hair, are very black and have the features Papuan. It is, therefore, probable that there are two races of aborigines." Mathew (1899, 13) moreover, says; "The occurrence of strongly contrasted complexions, copper and almost jet black in the same tribe is exceedingly common. Some of the fairer skins are accompanied by light colored hair, whether faded or natural." Dixon (1923, 374) favors the view that the lighter color is that of the Protoaustraloids; the darker color is that of the Protonegroids, a later migration into Australia.

EYE COLOR

Of the 6 pure blood males the eye color was classed as "dark brown" in 5 cases, and as "brown" in one case, that of Clyde Marshall. In his skin color Clyde Marshall has more of the "white" element than the others, which may be regarded as parallel with the lightening of the hair color. One of the males had striking brown spots on the cornea; a condition which is most marked among Papuans and to a less degree among Malays, Melanesians, and Negroes (Martin, 1914, 409).

Among the 7 women the eye color is recorded as dark brown in 4 cases; brown in 2 cases of which one is "fading to bluish" in a woman of

66 years and in one case as "faded to bluish (brown?)," in Mary Travers, about 90 years old. This is an instance of loss of pigment in a very old person. In two of these women there were striking brown spots in the cornea.

HAIR COLOR

In the 6 male full bloods the hair was, in all cases, black; 3 of the men at 62, 62 and 64 years respectively showed some gray, and one of the men at 70 ± years was bald on top but not gray. All of the 7 women had black hair except Mary Travers whose hair at 90 ± years was "gray." Thus graying of the hair is a phenomenon that is present in Australian aborigines, as it is indeed in all peoples, as well as anthropoid apes and lower mammals. But the appearance of gray hair seems to be retarded in these Australians as in many other primitive peoples.

HAIR FORM

The frequency of occurrence of the different types of hair form in the 13 full bloods is indicated in the following table.

Hair form:	Straight	Wavy and slightly wavy	Wavy-curly or open curly	Curly
Males	1	2	2	1
Females	1	5	0	1

This table indicates that wavy hair is the predominant form of hair in the full bloods at Brewarrina. Apparently Houzé et Jacques got the same result, since their subjects had hair that was "rather straight," "undulating," "of cylindrical section."

The fact is, however, that the head hair varies greatly in the Australian natives, straight, wavy and curly occurring with almost equal frequency. This fact has been regarded as proof of the racial heterogeneity of the Australians. They combine the hair form of the East Indians, with that of the Papuans; but intermediate types of hair in various degrees are the most common.

PULSE AND RESPIRATION

The distribution of pulse rates in the 13 full bloods seen at Brewarrina varied as follows (all counted at the left wrist, subject seated):

Beats per minute	50–59	60–69	70–79	80–89	90–99	100–over
Brewarrina, males			3	1	1	1
Brewarrina, females	1	1	2	2		1
Houzé et Jacques, males				2		2
Houzé et Jacques, females				1		1

Thus the pulse rate varied greatly; no doubt the degree of emotional disturbance of the subject varied also and caused the variation in pulse. Houzé et Jacques found even higher average pulse rates than I, which may have been associated with the tuberculosis which was becoming active in some of their subjects.

The number of inspirations per minute was as follows:

	20–23	24–27	28–31
Brewarrina (author)	1	5	3
Houzé et Jacques	3	1	2

ORAL TEMPERATURE

The oral temperature was determined by a clinical thermometer (Fahrenheit) for 12 of the adults, with the following results.

36.45–	36.7°–	36.95–	37.2	37.45°	Centigrade.
97.5–97.9	98.0–98.4	98.5–98.9	99.0–99.4	99.5–99.9°	Fahrenheit.
3	2	1	5	1	

For Europeans 98.4° is generally regarded as normal. An exceptionally large proportion of these full bloods show a temperature of 99° or over.

AUSTRALIAN MONGRELS

The great majority of the residents at the Brewarrina reservation were hybrids in varied degree between Australian blacks and whites. The measurements taken among such hybrids are given in Table B. Among them the first generation (or alleged first generation) is of special importance in any study of heredity. Accordingly, a brief table (Table 7) is given of the traits observed in them.

TABLE 7. F_1 GENERATION BETWEEN ABORIGINES AND WHITES.

Nos. of Tab. B.	Names	Sex	Age	Rel. Sit. Ht.	Rel. Span	Ceph. Index	Rel. Chest Girth	Pelvis Chest	Rel. sh. breadth
53	Tom Sullivan	♂	57	52.4	103.2	79.7	63.9	—	26.4
38	—— McIntosh	♀	49	50.6	101.8	67.5	50.6	—	21.4
46	Nellie Coleman	♀	48	52.4	94.5	73.7	55.5	94.4	22.9
19	Peter Williams	♂	35	50.9	103.6	74.2	50.6	—	25.1
16	Jack Simpson	♂	24	51.2	106.6	75.3	50.8	95.9	22.6
17	Topsy Pinkley	♀	24	53.3	102.2	80.1	47.9	108.5	22.7
32	Katie Clark	♀	25	50.6	101.2	80.4	50.9	98.8	22.4

TABLE 7 (*Cont'd*). F_2 GENERATION BETWEEN ABORIGINES AND WHITES.

Nos.	Hair Color	Form	Eye Color	Skin Color				N+R
				N	R	Y	W	
53	black	wavy	dk. br.	34	40	14	12	74
38	black	sl. wavy	dk. br.	28	42	15	15	70
46	black	wavy	———	30	40	5	15	70
19	black	wavy	dk. br.	22	34	22	22	56
16	black	straight	med. dk. br.	47	41	9	3	88
17	dk. br.	straight	med. dk. br.	28	33	18	21	61
32	dk. br.	wavy	dk. br.	20	40	16	24	60

Skin Color: N, black; R, red; Y, yellow; W, white.

F_1 GENERATION

Relative Sitting Height. All seven of the F_1 generation had a sitting height greater than the average of full blooded Australians and in 4 cases quite like that of Caucasians. Growth in leg length seems to be damped down by the crossing with the shorter legged race. Short leg is dominant in the hybrids, just as was found in my study of stature (1917, 357).

Relative Span. Four out of seven had the Caucasian relative span. All but one had a relative span below the average of the full bloods. It is probable that there is a dominant shortening factor to arm growth also in the Caucasian.

Cephalic Index. The hybrid index is above the Australian average of the same sex in 6 out of 7 cases. It appears that brachycephaly tends to dominate over dolichocephaly. Cephalic indexes as high as 80, or even 77, seem rarely to be found in full-blooded Australians.

Relative Chest Girth is, for the most part, below that of Australian natives; but there is one outstanding exception in the case of Tom Sullivan. Apparently the slender relative chest girth of the Australians is preserved in the hybrids despite their short legs. Also the chest in relation to pelvis seems to be small. The suspicion is raised that the physique of the F_1 generation is inferior to that of the full bloods.

Relative Shoulder Breadth. This is small, like the Australian dimension, in the women and large in 2 of the 3 men. Thus the sexual dimorphism in relative shoulder breadth which is so striking of character of Europeans, as contrasted with Australians, reappears in the F_1 generation.

Hair color. All of the F_1 generation have black, or dark brown hair. This result agrees with experience that the darker grades of hair color dominate over the lighter ones.

Hair form. Of the 7 cases, 5 have wavy and 2 have straight hair. No conclusion can be drawn in absence of data about the form of the hair in the parents. In Europeans wavy is typically a heterozygous (hybrid) condition resulting from the crossing of curly and straight hair. Straight usually dominates imperfectly over curly.

Eye color. Here the dark eyes of the Australian dominate over all other colors.

Skin color. The average amount of N in skin color in the hybrids is considerable—from 20 to 55 per cent. For the most part the proportion of N in the skin of these hybrids is like that of negro-white mulattoes (Davenport, 1913, p. 11).

The yellow element is fairly high in the hybrids (5 to 22 per cent), though it does not run quite so high as in the case of negro-white mulattoes (11 to 30 per cent). Apparently the Australians do not inherit quite the same degree of xanthism that Mongolians, Amerindians and Negroes enjoy.

Table B shows clear evidence of segregation of traits. Thus blue or hazel* eyes appear in Janet McHughes, Lilly Holt and Grace Wye ("clear blue"). These are colors that are not found in full bloods or in the F_1 generation. In the Wye fraternity skin grades of N 24 per cent and N 33 per cent appear. These are low to median values; the F_2 fraternity is variable. Esther McHughes, No. 29 and Robert (No. 28), her brother, had N 32 per cent and 53 per cent respectively, again great variability in skin color.

Again Peter Williams was of half blood and has a rather dolichocephalic head (74.2); his wife was still more dolichocephalic (72.6). Their 3 children had heads that were mesocephalic, C. I. 78 and 79. It was noted at the time that the girls at 7 and 9 years showed no supraorbital ridges. Though the data are inconsiderable, and there was little chance for the study of families, as such, there is clear evidence of the segregation of traits.

GENERAL DISCUSSION

The fragmentary data obtained at Brewarrina hardly qualify me to throw important light on the problem of the origin and relationships of the Australian aborigines; yet they bear on that problem. Also, modern genetics may throw light on the problem. Consequently a brief consideration may be given to it.

The first element of the Australian problem is that of the origin of the population of the continent as found by the early explorers and more recent investigators of the natives. Are the Australian aborigines to be considered a single race derived from an original native "Adam and Eve" or a single boat load of settlers coming from some other country? To the anthropologist who observes the tendency of most peoples to wander, the present proximity of Australia to New Guinea and the Malay Archipelago makes it certain that an interchange of blood between the two countries must have taken place repeatedly. Indeed there are groups of people on points of the north shores of Australia that closely resemble Papuans. Also there is evidence that Papua and Australia until recent geologic times had a land connection over the shallow island-filled strait that now separates them.

Whether, apart from these minor exchanges, the population of Australia is mono- or poly-phyletic is a much mooted question. Topinard

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*Hazel is used in the sense of a blue iris not over one-third covered by brown pigment.

(1872, 106) concluded that there were two main races involved, first, a tall, dolichocephalic, lighter skinned, straight haired race and, secondly, a still more dolichocephalic, but short race, with black skin and frizzly or curly hair. Mathew (1899) concludes that Australia was first inhabited by "a branch of the Papuan family and closely related to the Negroes;" there followed one, if not two, invasions by persons some of Dravidian and later some of Malay blood. The latter were lighter in color with straight hair. Mathew adopted this theory as one best fitted to the view that the woolly haired Tasmanians were probably the first comers, who were pushed off the continent by the later immigrants. He points out that the Australians as found by the first explorers and settlers varied in color from black to copper color; in hair form from straight to frizzly or woolly; in stature from an average of 65 inches (165 cm.) to 69 inches (175 cm.). Dixon (1923, p. 373) favors Mathews' view, and Spencer and Gillen, Roth and Howitt accept the conclusion of dual origin. But Huxley, Wallace, J. W. Gregory, Deniker and others, including various explorers on the continent, regard the race as a monophyletic one, which has undergone a certain amount of differentiation in place, just as the American Indian has differentiated in the Americas. We do, indeed, find the Karayas of Matto Grosso, Brazil, prevailingly dolichocephalic (cephalic index, 73); Indians of Patagonia more or less brachycephalic (cephalic index up to 85). Some Indians are short like, for example, some of the Caribs (157 cm.) and others tall like the Cheyennes (175 cm.). The eye differs in its form from "straight" to "oblique." Indians differ in color also; the Moscos of the Mosquito Coast being said to be "almost black like Negroes"; while along the north-west coast of North America the normal color of the Indians is very perceptibly lighter than the average. Now if in the American continent, whose population south of the Eskimo district is generally regarded as monophyletic, all these modifications and mutations have arisen, the argument for polygenesis of the Australian aborigines on the ground of their variability in these same traits loses much of its force. There is, in general, no reason for insisting that all persons with a particular physical trait are related. A mutation that has occurred once may occur a second time wholly independently of the first, except in so far as both mutations arise from the same kind of germ-plasm, i.e., with the same potentialities of mutation. Breeders of animals, especially of the fruit fly, Drosophila melanogaster, find that the same mutation arises independently even from different wild stocks. This is the case, for example, with yellow body and with vermillion eye color

(Morgan and Bridges, 1916, 27). The same mutation (yellow) was found in a different, though closely related species, Drosophila simulans. "Parallel variation" or repeated independent identical mutation is no longer a matter of speculation; it is a demonstrated fact. Anthropologists should take note of this advance in our knowledge. As for the Australian aborigines, it can only be said that the theory of their polyphyletic origin is not proven.

The Tasmanian problem can not be overlooked. On the island south of Australia, separated by a narrow strait containing many islands, lived a people who were shorter than the average of Australians, had a slightly darker complexion and had hair that generally grew in long, thin, corkscrew ringlets. They were frizzly headed. It seems to be true that some of the Australian aborigines of the mainland adjacent to Tasmania partook of some of the differential characters of the population of the island. Still, this is not proof that the Tasmanians were the early inhabitants of Australia. They may have come from the north along the Australian coast, either east or west. Established in Tasmania they would naturally make contacts with the adjacent mainland. Here again we have insufficient knowledge of the South Australian aborigines and their precursors to decide whether the ancestors of the Tasmanians ever occupied that territory.

We must next free ourselves from the tendency to consider merely present races of the globe in relation to Australians, and view the human species in time as well as space. There is so much in the skull of the Australian that is Neanderthaloid that we are led to attempt to reconstruct the probable range of that type, first recognized from European fossils. After the retreat of the second (or third) glacier in the so-called Mousterian culture period, there appeared in Europe, and persisted for a long time, a race of men called Neanderthal. This race was characterized by the possession of a skull that was dolicho- to mesocephalic and had heavy brow ridges. The total stature averaged about 163.5 cm. which is about that of Sicilians and many tribes of India—below the general average of Europeans. The appendages were relatively short.

Now dolichocephalic skulls with occasional rather heavy brows are found in areas of greater or less size from Europe to Australia, along the northern shores of the Indian Ocean, and among very primitive peoples characterized also by the primitive black (or chocolate) skin color and straight (or wavy) hair. Such are the Weddahs of Ceylon; Certain groups of the Dravidians, such as the Todas, and the Australians. The hypothesis seems more satisfactory that these recent peoples are all relics of a formerly widespread race of Neanderthaloids than that Australia was settled by Dravidians, as some have maintained. From this assumed dolichocephalic, heavy-browed, black-skinned, straight-haired ancestor various races may conceivably have arisen, we may believe, by mutation and came to occupy Europe, Asia and Africa. One mutation led to a loss of black pigment as in the Ainus. Another mutation, possibly a reduced endocrine (thyroid?) activity of the pregnant mother, causes many processes of differentiation to stop before birth so that the offspring show many fetal proportions and traits, as in the Chinese (Davenport, 1924). Other mutations led to the loss of most black and most yellow pigment and the supraorbital prominence, producing the white race; and in this group brachycephaly may have arisen by a mutation independent of that which produced it in the Chinese. Finally, mutations of quite a different sort produced the woolly hair of the negro and the frizzly hair of Melanasians—peoples which in their turn have come to occupy great areas. Of course, special problems of origins there are in plenty in anthropology not touched by this discussion. In this discussion I seek only to emphasize the point that the history of any distinct race had probably its beginnings in an early time, perhaps from a race which is known only in the fossil condition. And when Huxley, Luschan and others found in the native Australian a persisting Neanderthal man, they would not have wished to exclude the obvious expectation that points of difference from the European remains of Neanderthal man should have appeared in Australians, but rather they would maintain that the Australian race represents the largest surviving race of people who show a persistence of many archaic characters,—evidence that they have not evolved so far as most other races from the ancestral human stock.

SUMMARY

The measurements and observations on 6 male and 7 female full blooded Australian aborigines are recorded. The sitting height is exceptionally low on account of the length of their legs which is probably the greatest of any living race. The relative span is not as extreme as the relative leg length. In the relation of span to leg length Australian aborigines resemble European children of 10 to 12 years.

The head is extraordinarily dolichocephalic, in this respect resembling the New Guinea and Caroline Islanders and Neanderthal man. The relative chest girth is low but higher in the full blood than half breeds. The arms and legs are relatively slender.

Skin color is darker than that of negroes of Jamaica and Bermuda. There is a great variability in skin color which has been observed by others and has led to the conclusion that there are two races of aboriginals; one resembling the Papuan and the other the Malays. But the result may be due to mutations that have arisen in Australia.

The eye color is a dark brown and the hair is also dark brown or black. The hair is prevailingly wavy, tho straight and curly hair occur.

Oral temperature was, in the majority, above the standard of Europeans.

A number of mongrels were also studied. The first generation have relatively short legs and span and the cephalic index is less dolichocephalic. The relative chest girth and relative shoulder girth are small. Hair and eye color is generally dark showing dominance of the Australian pigmentation.

The skin color of the hybrids is like that of the negro mulattoes. The yellow element is not so high as in mulattoes.

LITERATURE CITED

Chalmers, J.—1897. Anthropometrical Observations on Some Natives of the Papuan Gulf. *J. Anthrop. Inst.*, XXVII, 335 pp.

Davenport, C. B.—1913. Heredity of Skin Color in Negro-White Crosses. *Carnegie Inst. Wash. Publ.* 188, 106 pp. (based on Miss F. A. Danielson's observations).

Davenport, C. B.—1917. Inheritance of Stature. *Genetics*, II, 313.

Davenport, C. B., and Love, A. G.—1921. Army Anthropology; *in Med. Dep. U. S. Army in the World War*, XV, Part I, 635 pp.

Davenport, C. B.—1924. Influence of Endocrines on Heredity. *Proc. Am. Ass. Study Feeble-Minded*, for 1924.

Fraser, John.—1892. The Aborigines of New South Wales. Sydney, Gov't Printer: *N. S. W. Comm. for the World's Columbian Exposition*, Chicago, 1893.

Houzé et Jacques.—1884. Sur les Australiens du Musée du Nord. *Bull. Soc. Anthrop. Brux.*, III, 53–153. Pls. I–III.

Koch, J. W. R.—1908. Bejdräge tot de anthropologie der bewoners van zuidwest Nieuw Guinea. 8°, Leiden.

Martin, R.—1914. Lehrbuch der Anthropologie. 8°, Jena.

Mathew, J.—1889. The Australian Aborigines. *J. Roy. Soc. New So. Wales*, XXIII, 335 pp.

Mathew, J.—1889. Eaglehawk and Crow. 8°, London. 288 pp.

Mayet, L.—1913. Les Neolithiques des Montouliers. *L'Anthroplogie*, XIII, 53.

Pöch, R.—1915. Studien an Eingeborenen von Neu-Südwales und an australischen Schädel. *Inaug. Diss.*, München. 94 pp.

Morgan, T. H., and Bridges, C. B.—1916. Sex Linked Inheritance in Drosophila. *Pub. Carneg. Inst. Wash.*, No. 237, 87 pp.

Ried, H. A.—1915. Zur Anthropologie des abflusslosen Rumpfschollenlandes im nordöstlichen deutsch-Ostafrika. *Abh. Hamb. Kolonialinst.*, XXXI.

Seaver, J. W.—1909. Anthropometry and Physical Examination. 12°, New Haven, Conn.

Seligman, C. G., and Strong, W. M.—1906. Anthropological Investigations in British New Guinea. *Geogr. J.*, XXVII.

Spencer, B., and Gillen, J. J.—1899. Native Tribes of Central Australia. London. 1904. The Northern Tribes of Central Australia. London.

Sterling, E. C.—1906. Anthropology. Rep't on work of Horn Scientific Expedition to Central Australia. Pt. IV. London: Dulau and Co. 200 pp.

Topinard, P.—1872. Étude sur les races indigènes de l'Australie. 8°, Paris.

Virchow, H.—1883. Australier. *Z. f. Ethnol.*, XV; *Verh. Berl. Ges.*, 190–193.

TABLE A. AUSTRALIAN (N. S. W.) ABORIGINES. FULL BLOOD.

No.	Name: Females	Age yrs.	Ht. cm.	S. Ht. cm.	Rel. S. Ht. p.c.	Span cm.	Rel. Span p.c.	Head		Ceph. Indx p.c.	Face Lth. cm.	Chest Rest cm.	Girth Insp. cm.	Rel. Ch. g p.c.	Pel. Girth less 3 cm.	Pel. g. / ch. g. p.c.
								Wth. cm.	Lth. cm.							
1.	Mary Travers	90±	148.	71.5	48.3	144	97.3	14.3	19.5	73.3	12.5					
2.	Polly Marshall	66±	147.	73.2	49.8	162	110.2	13.7	18.3	74.9	10.3	86.4	87.1	58.8		
3.	Kate Mitchell, Mrs. Shepard	24	150.	73.0	48.7	159	106.0	13.2	18.4	71.7	11.0	68.0	70.0	45.3	85	125.0
10.	Mary Marshall, Mrs. Mary Brown	37±	161.3	81.0	50.2	167	103.5	14.5	20.3	71.4	11.5	84.0	85.8	52.1	99	117.8
13.	Judy Warrawina	58	147.8	72.5	49.1	151	102.1	13.4	18.3	73.2	11.5	89.5	90.5	60.5		
14.	Jennie Sargent	37	158.5	80.0	50.5	163	102.8	13.4	19.1	70.2	11.5	72.0	76.5	45.4	86	119.4
15.	Miriam Coleman	65	153.	75.0	49.0	157	102.6	14.5	19.8	73.2	12.0					
	Average		152.2	75.2	49.4	158	103.5	13.9	19.1	72.6	11.5	80.0	82.4	52.4	90	120.7
No.	Name: Males															
4.	Cobra Charlie	70±	173.	83.5	48.3	175	101.1	15.1	19.8	76.3	12.8	100.3	102.9	58.0	99	98.7
6.	Steve Shaw	62	165.5	83.5	50.4	170	102.7	14.5	19.4	74.7	11.8	91.4	97.8	55.2	99	108.3
5.	Paddy Shepard	32	166.	82.0	49.4	179	107.8	14.1	19.0	74.2	12.5	79.5	84.5	47.9	86	108.2
7.	Clyde Marshall	62	165.5	85.0	51.3	174	105.1	15.1	21.5	70.2	13.3	90.0	93.0	54.4	96.5	107.2
8.	Jimmy Mitchell	64	165.	81.0	49.1	173	104.8	14.5	19.2	75.5	11.5	84.0	87.5	50.9	86	102.4
9.	Johnny Mitchell	35±	167.	84.0	50.3	182	109.	14.7	19.0	77.4	12.2	85.2	88.9	51.0	83.5	98.0
	Average		167.	83.1	49.8	175	105.1	14.7	19.7	74.7	12.3	86.7	92.4	52.9	91	103.8

TABLE A. Cont'd. AUSTRALIA (N. S. W.) ABORIGINES. FULL BLOOD.

No.	Calf Gir. cm.	Shl. Bth. cm.	Rel. Shl. wth. p.c.	Up. arm		Gir. low. arm	Hair Color	Hair Form	Eye Color	N	Skin color		W	Pulse	Res-pir.	Temp. (oral)	
				rest cm.	flex. cm.						R	Y					
1.		35.5	24.0				gray	sl. wa	faded to blue (brown?)	73	18	3	6	55±		98.5	
2.	25.0	37.0	25.2				black	curly	br; fading to blue	68	22	5	5	136±	28	97.5	(a)
3.	25.0						black	wavy	dk br	64	22	5	9	84	17	99.0	(b)
10.	31.5	36.2	22.4	25.0	27.5		black	wavy	br; br. in cornea	64	23	5	8	78	24	99.1	(c)
13.	28.5	35.2	23.8	24.5	26.0		black	str.	dk br	73	21	4	2	84	24	99.6	(d)
14.	29.0	40.0	25.2	24.0	28.0	22.0	black	wavy	dk br; br. spts in cornea	(48	32	14	6)	72	22	99.4	(e)
15.	25.5	34.0	22.2	24.5	26.5	21.0	black	wavy	dk br	62	28	8	2	60			(f)
Avg.	27.4	36.3	23.8	24.5	27.0	21.5				*68	22	5	5			98.6	
*Except No. 14.																	
4.	33.0	33.0	19.1				bk, bld open							98			
							on top	curl	dk br	68	23	3	6	wk	24	98	(g)
														73			
6.	32.5	38.0	23.0			28.5	bk,(g)	wavy	dk br	67	23	5	5	sg	24	97.5	(h)
5.	33.0	42.0	25.3			27.5	bk; tr.							72			
							gray	wa-cu	dk br	66	22	5	7	md	17	97.8	(i)
7.	38.5	43.0	26.0	34.0	37.2		black	curly	brown	68	19	3	10	88	28	99.4	(k)
8.	29.0	40.0	24.2	26.5	31.5		bk,(g)	sl wa	dk br	68	21	7	4	74	24	98.9	(l)
9.	30.0	38.5	23.1	25.5		24.5	black	str	dk br; br spts in cornea	66	28	4	2	130?	28	99.0	(m)
Avg.	32.7	39.1	23.4	28.7	34.4	26.8				67	22	4.5	5.5			98.4	

ADDITIONAL DATA.

(a) Wife of No. 7. (b) Dau. No. 8; Bro. No. 9; Wife No. 5. (c) Dau. No. 2. (d) Has 11 children; 3 dead, 4 full blood, 4 half caste; no other relatives. (e) M and F each full black. A "Bogon black." (f) Has had 4 children. Her F and M full blood. (g) Beard, heavy, white. (h) Beard, heavy, black, wavy. (i) Beard black. Husband No. 3. Very hairy body. (k) Beard black, full, curly. Husband No. 2. (1) Beard, abd. gray, wavy. F of Nos. 3 and 9. Very hairy body. (m) Black. Son of 8; bro. No. 3.

ABBREVIATIONS, (TABLE A).

bir., birth; bld, bald; br., brown; cm., centimeter; cu or cur, curly; di., diameter; dk, dark; g, or gr., gray; gir, girth; ht, height; insp., inspiration; low., lower; lth, length; N, black; p.c., per cent; pel. g., pelvic girth; pul., pulse; R, red; re., respiration; rel, relative; rel. ch. g., relative chest girth; rel. s. ht., relative sitting height; S, sex; shl., shoulder; sg, strong S. ht., sitting height; sl., slightly; spts, spots; str., straight; temp., temperature; tr., trace; up. upper, W, white; wa., wavy; wk. weak, wth, width; Y, yellow.

TABLE B. AUSTRALIAN ABORIGINES: FEMALES AND FAMILIES. MIXED BLOOD.

No.	Name	S.	Ag. yr.	Ht. cm.	S. Ht. cm.	Rel. S. Ht. p.c.	Span cm.	Rel. Span p.c.	Head		Ceph. Indx p.c.	Face Lth. cm.	Chest Rest cm.	Girth Insp. cm.	Rel. ch. g. p.c.	Pel. Girth less 3 cm.	Pel. g. / ch. g. p.c.
									Wth. cm.	Lth. cm.							
11.	Ada Sullivan	f	33	159.0	80.0	*50.3*	167.5	*105.3*	13.9	19.8	*70.2*	11.5	102.9	107.3	*64.7*	113.8	*109.6*
12.	Ada Picketon	f	29	161.4	80.0	*49.6*	170.0	*105.3*	14.7	19.8	*74.2*	12.5	88.0	91.5	*54.5*	98.6	*112.0*
16.	Jack Simpson	m	24	167.0	85.5	*51.2*	178.0	*106.6*	14.3	19.0	*75.3*	12.8	84.8	87.2	*50.8*	81.3	*95.9*
17.	Topsy Pinkley	f	24	156.5	83.5	*53.3*	160.0	*102.2*	14.1	17.6	*80.1*	12.2	75.0	81.0	*47.9*	81.4	*108.5*
18.	Jackie Simpson	m	3						13.1	16.0	*81.9*						
19.	Dorrie Simpson	f	1														
20.	Peter Williams	m	35	167.5	85.0	*50.9*	173.0	*103.6*	14.7	19.8	*74.2*	13.0	84.5	88.5	*50.6*		
21.	Mary Williams	f	32	157.2	76.5	*48.7*	161.0	*102.4*	13.8	19.0	*72.6*	12.5	81.0	85.5	*48.5*	83.4	*103.0*
22.	George Williams	m	10						14.2	18.3	*77.6*	11.2					
23.	Gladys Williams	f	9						13.4	17.1	*78.4*	11.0					
24.	Edith Williams	f	7						13.4	16.9	*79.3*	11.0					
25.	May Williams	f	4														
26.	Janet McHughes	f*	35	159.8	83.7	*52.4*	162.0	*101.4*	14.5	18.7	*77.5*	12.0	79.0	80.0	*49.4*	88.4	*111.9*
27.	Robert McHughes	m	[Husband of Janet, absent]														
28.	Robert McHughes	m	8						14.0	17.7	*79.1*	11.6					
29.	Esther McHughes	f	10						13.8	18.0	*76.7*	10.0					
30.	Maggie McHughes	f							13.1	17.0	*77.1*	97.0					
31.	Elsie McHughes	f															
32.	Katie Clark (Mrs. Hilt)	f	25	165.0	83.5	*50.6*	167.0	*101.2*	14.8	18.4	*80.4*	12.5	84.0	88.0	*50.9*	83.0	*98.8*
33.	Charlie Hilt	m	27	167.0	85.0	*50.9*	178.0	*106.5*	14.2	19.0	*74.7*	12.8	88.0	95.2	*52.7*		
34.	Lily "Hilt"	f	8						13.1	17.1	*76.6*	10.0					
35.	Harry Hilt	m	6						13.1	18.7	*70.1*	10.3					

TABLE B. (CONT'D). AUSTRALIAN ABORIGINES: FEMALES AND FAMILIES. MIXED BLOOD.

No.	Name	S.	Ag. yr.	Ht. cm.	S. Ht. cm.	Rel. S. Ht. p.c.	Span cm.	Rel. Span p.c.	Head Wtd. c.m.	Head Lth. c.m.	Ceph. Indx p.c.	Face Lth. c.m.	Chest Rest c.m.	Girth Insp. c.m.	Rel. ch. g. p.c.	Pel. Girth less	Pel. g. / ch. g. p.c.
36.	Liza Sherwood	f	49	156.0	81.0	*51.9*	165.0	*105.8*	14.2	20.0	*71.0*	11.8	93.0	95.2	*59.6*		
37.	Caddy Parker	f	67	149.0	78.5	*52.7*	148.0	*99.3*	14.7	19.4	*75.8*	11.3	88.5	94.0	*59.4*	88.5	*100.0*
38.	———McIntosh (Mrs. Fred Wye)	f	49	168.0	85.0	*50.6*	171.0	*101.8*	13.5	20.0	*67.5*	12.2	85.0	88.5	*50.6*		
39.	Fred Wye	m															
40.	Grace Wye	f	12	150.0	75.0	*50.0*	155.0	*103.3*	14.0	18.4	*76.1*	11.2	72.0	77.5	*48.0*		
41.	Alfred Wye	m	10						14.2	18.6	*76.3*	11.5					
42.	Charlotte Wye	f	7						14.3	18.1	*79.0*	10.2					
43.	Ilene Wye	f	5						13.3	16.9	*78.7*	94.					
44.	Rosie Wye	f	3														
45.	Ivy Wye	f	1/12														
46.	Nellie Coleman	f	48	164.0	86.0	*52.4*	155.0	*94.5*	14.0	19.0	*73.7*	12.8	91.0	92.0	*55.5*	85.9	*94.4*
47.	Henry Coleman	m	10						14.0	19.4	*72.2*	11.2					
48.	Bertie Coleman	m	8						14.4	18.5	*77.8*	11.3					
49.	Connie Coleman	f	6						13.4	16.8	*79.8*	11.0					
50.	Fred Wellington	m	9														
51.	Geo. Dunn	m	27	168.4	85.6	*50.8*	183.0	*108.7*	14.1	19.6	*71.9*	13.1	94.0	97.7	*55.8*	91.0	*96.8*
52.	Emily Darcy (Emily Dunn)	f	20	171.7	84.3	*49.1*	180.0	*104.8*	13.8	18.6	*74.2*	11.9	86.4	91.4	*50.3*	88.0	*101.8*
53.	Tom Sullivan	m	57	155.0	81.2	*52.4*	160.0	*103.2*	15.3	19.2	*79.7*	13.0	99.0	101.6	*63.9*		
54.	Lily (Dunn) Sullivan	f	48	153.5	79.5	*51.8*	159.0	*103.6*	14.3	18.7	*76.5*	12.9	106.7	108.0	*69.5*		

*Had 5 sons, 3 died; also 3 daughters, all living.

TABLE B (CONT'D). AUSTRALIAN ABORIGINES: FEMALES AND FAMILIES. MIXED BLOOD.

No.	Calf Girth cm.	Shl. Bth. cm.	Rel. Shl. wth. p.c.	Up. Arm		Girth Lower Arm cm.	Hair Color	Hair Form	Eye Color	Skin Color				Pul.	Re.	Temp. Oral	
				sup. cm.	flx. cm.					N	R	Y	W				
11.	34.0	38.0	23.9	29.5	32.5		dk br+ red br	nly. straight	dk br	60	26	9	5	70	26	99.6	(a)
12.	31.0	37.0	22.9	25.0	27.0		dk br+ red br	sl. wave	dk br	64	23	8	5	104	25	99.4	(b)
16.	31.9	37.8	22.6	25.0	29.0	25.0	black	straight	med br	47	41	9	3	104	28	99.0	(c)
17.	29.0	35.5	22.7	22.5	25.0	21.7	dk br	straight	med br	28	33	18	21	104	26	99.2	(d)
18.							med br	straight	dk br	27	33	17	23				
19.							yell br	straight	dk br			(y)					
20.	30.7	42.0	25.1	29.0	32.5	27.5	black	wavy	dk br	22	34	22	22	72	24	98.2	(e)
21.	27.0	34.0	21.6	25.0	27.0	22.5	v dk br	wavy	dk br	29	35	18	18	72	18	98.6	(f)
22.							blk from bir.	straight	dk br	37	40	14	9				
23.							med br	strght; sl.wa	v dk br	47	36	8	9				(g)
24.							brown; darker than No. 22.	sl. wave	dk br	55	30	9	6				(g)
25.							lightest, exc. baby										(h)
26.	29.0	32.0	20.0	25.0	27.5	23.0	dk br+ br red	strght; sl. wa.	br spots on pale blue	17	32	17	34	78	26	99.8	(i)
27.							v dk br	straight	med br	N. probably 50±							(k)
28.							black	straight	dk br	53	32	8	7				
29.							dk br;	nly straight	med br								
							b. black			32	37	16	15				
30.							light br.	curly	med br								
							b. yell-brown			35	35	15	15				
31.							yellow at bir.	wavy	blue								
32.	31.0	37.0	22.4	24.5	26.5	22.5	dk br	wavy	dk br	20	40	16	24	116	29	98.6	(l)
33.	32.0	45.0	26.9	29.0	32.5	28.0	v dk br	wavy	dk br	35	39	14	12	76	24	99.7	(m)
34.							med br	straight	br. at pupil; rest blue	10	20	9	61				(n)
35.							golden at bir. now brown	straight	dk br	34	36	12	18				(o)
36.	32.0	40.0	25.6	32.0	32.5	23.5	v dk br	sl. wavy	dk br	40	41	12	7	88	25	99.0	
37.	30.5	36.5	24.5	27.0	29.0	21.5	black	straight	dk br	32	42	14	12	100	30	99.6	(p)
38.	32.3	36.0	21.4	25.0	27.5	23.5	black	sl. wavy	dk br	28	42	15	15	92	28	98.9	(q)

TABLE B (CONT'D). AUSTRALIAN ABORIGINES: FEMALES AND FAMILIES. MIXED BLOOD.

No.	Calf Girth cm.	Shl. Bth. cm.	Rel. Shl. wth. p.c.	Up. Arm sup. cm.	Up. Arm flx. cm.	Girth Lower Arm cm.	Hair color	Hair Form	Eye Color	N	Skin Color R	Skin Color Y	Skin Color W	Pul.	Re.	Temp. Oral	
39.							black	straight	med br								(r)
40.	29.5	31.0	20.7	20.0	21.8	20.5	brown	wavy	cl. blue	24	44	15	17	94	25	99.8	
41.							brown	straight	dk br	32	39	17	12	64	25	99.0	
42.							brown	straight	brown	33	37	15	15				
43.							brown	straight	dk br	33	38	15	14				
44.							med br	straight	dk br								
45.							br	straight?									
46.	32.0	37.5	22.9	26.5	28.5	22.5	black	wavy		30	40	5	15	72	23	99.0	(s)
47.							black	str	dk br	62	34	6	0				
48.							black	str		62	34	6	0				
49.							black+br	strght; sl.wa		64	31	5	0				
50.							black	open curl or close wave	dk br; br on cornea								
51.	33.6	41.9	24.9	28.5	35.0	28.0	black	coil 3 cm. di	Med br; br on cornea	66	30	4	0				(t)
52.	30.8	41.2	24.0	24.0	27.0	23.8	v dk br	straight	dk br	62	28	10	0	88	22	99	(u)
53.	38.0	41.0	26.4	34.0	37.5	29.4	black	wavy	dk br	37	38	13	12	88	20	98.9	(v)
54.	33.7	43.0	28.0	37.0	40.0	25.6	black	wavy	dk br	34	40	14	12	88	26	99.4	(w)
										45	35	12	8	102	34	99.1	(x)

ADDITIONAL DATA

(a) F, Tom Sullivan, No. 53, half blood, M. full blood. Ada has 4 chldren by ——— Howell. (b) wife of Alf. Sullivan, son of Tom Sullivan, No. 53. (c) F, white; M, full blood. (d) wife of Jack Simpson. Her F, white; M, full blood. Mar. 3 yrs. 1 boy Jackie; 1 girl Dorrie. (e) slight overhang at brows. F, White; M, full blood. Eyes darker than any of his children's. (f) wife of Peter Williams. Four children as follows, and a baby of 10 months. (g) no overhanging brow. (h) a baby sister at 10 months has white hair. (i) M, full blood; F, white; children Nos. 28–31; (k) No. 27 of mixed blood. Jimmy Mitchell No. 8 (full blood) is mar. to Robt. McHughes' half sister, full blood. (1) M, full blood; F, white; brow smooth. Two children of No. 32 are Nos. 34, 35. (m) M. is Eliza Sherwood, No. 36, three-fourth black, F white. (n) white father. (o) Mother of No. 33; M, half caste; F, full blood. (p) M of Eliza Sherwood, No. 36, M, half caste; F, white. (q) M, full blood; F, white; 1 boy, 5 girls living, Nos. 41 to 45. Sister of No. 46. (r) M, Caddie Parker, No. 37, half caste; F, white. (s) Wife of William Coleman. M, full blood; F, white; sister No. 38; 5 sons, 1 dau., two of them seen, Nos. 48 and 49. (t) Full blood; nephew of Nellie C. No. 46. (u) Beard black full; M half blood (Lily Dunn—Lily Sullivan No. 54). (v) Face has darker patches over cheek bones. M, dark?; F, white. (w) Long beard, wavy. M, full blood; F, white; scanty hair on chin. Ada (Nall) daugh.-in-law: Mrs. Howell is daughter. (x) Hirsute, very. M, Mrs. Parker; F, full blood. Geo. Dunn's (No. 51) mother. (y) lighter than 18.

ABBREVIATIONS (TABLE B).

b, born; blk, black; br, brown; ceph., cephalic; ch., chest; exc., except; F, father; flx., flexed; g. or gir., girth; Ht., height; indx., index; insp., inspiration; lth., length; M, mother; N, black; nly, nearly; pel., pelvic; r., red; Rel., relative; Rel. S. Ht., relative sitting height; Re., respiration; Shl., shoulder; S. Ht., sitting height; sl, slightly; strght, straight; sup., supine; Sx., sex; Temp., temperature; Up., upper; v, very; W, white; wth., width; Y., yellow.

LITERATURE

ANTHROPOLOGY IN GENERAL

L'HISTOIRE DES SCIENCES ANTHROPOLOGIQUES ET L'ETAT ACTUEL DES INSTITUTIONS ANTHROPOLOGIQUES EN TCHÉCOSLOVAQUIE.—*Anthropologie*, Prague, 1924, II. Supplement, 85 pp.

This is an exemplary and very useful publication by the foremost representatives of the different branches of Anthropology in Czechoslovakia, compiled for the occasion of the 1924 reunion at Prague of the Institut International d'Anthropologie. It comprises the following articles (in French): Matiegka (J.)—History of Physical Anthropology in Czechoslovakia; *do.*—The Anthropological and Demographic Institute of the University of Prague, and the Anthropological Institute of the University of Brno; Dolenský (F.)—Institute for the Study of Children and Adolescents, Prague: Švácha (V.)—Physical Education in the Czechoslovak Republic; Šmotlacha (F.)—Physical Culture in the Colleges and Universities of Czechoslovakia; Haškovec (L.)—Eugenics in the Czechoslovak Republic; Netušil (F.)—Czechoslovak Demography; Štocký (A.)—The Development of Czech Prehistory; Schránil (J.)—The National Museum of Prague and the Museums of Bohemia, Moravia and Slovakia; Niederle (L.)—The State Archaeological Institute, Prague; Horák (J.)—History of the Study of Czech Folklore; *do.*—The Czech Ethnographical Museum, Prague; Chotek (K.)—Ethnography in Czechoslovakia, and the Ethnographical Museum of Náprstek, Prague.

ETHNICAL UNIT AND MILIEU. By Shirokogoroff (S. M.)—Shanghai, 1924, 8°, 36 pp.

The monograph is the author's revised translation of parts of his "Ethnos—General Principles of Ethnical and Ethnological Variations," published in Russian in 1923. He introduces a new term "Ethnos" which means "a group of people speaking the same language, recognizing their common origin, possessing a complex of customs and a social system, which is consciously maintained and explained as tradition, and differentiated from those of other groups. This is the ethnic unit in which the processes of variation (growth and decline) of all ethnological, linguistical and anthropological phenomena are running . . . Process of variation of these phenomena is a function of the biology of man who adapts himself to the geographical environment (climate, soil, other animal species, etc.) by the variation of his psychic, mental and physical capacities which assure his existence in the given physiographical conditions. From this standpoint the culture, or in other words human knowledge and experience appropriated by the previous generations and inherited, is a product of a purely biological function, and all phenomena of a physical, social, psychic and technical order are concrete manifestations of this process." The highly suggestive publication deals especially with the inter-ethnical *milieu* and relations, yet touches in many points also on the larger problems of physical anthropology.

Teorie konstitucionalismu a současné názory na normální stavbu těla lidského. (The Constitution Theory and Contemporaneous Views on the Normal Structure of the Human Body.) By Loth (Edward)—*Anthropologie*, Prague, 1924, II, 87–97 (Résumé in French).

Professor Loth shows that those who deal with human "constitution," a subject that has lately been receiving a great deal of attention in Germany and partly also in our country, often base themselves on erroneous assumptions. Features called primitive, regressive or subdeveloped, "signs of degeneration," etc., have not seldom quite a different significance. In proof of this are given valuable data on muscular, vertebral, costal and sternal anomalies.

EVOLUTION

L'origine de l'homme. By Mendes-Corrêa (A. A.)—*Scientia*, May, 1924, 339–350.

A good comprehensive view of the subject. With all our increasing knowledge we are still far from the solution of the problem of man's origin. The problem is, in fact, becoming more complex. There are great difficulties of geological, geographical, and chronological as well as of a biological nature.

The Present Position of the Darwinian Theory. By MacBride (E. W.)—*Science Progress*, 1923, XVIII, No. 69, 76–96.

"In its general outlines the Darwinian theory of evolution is as securely based as ever it was. . .it has withstood all the assaults of "Mutationism" and "Mendelism," the relevancy of which to evolution has been given up by their principal exponents. "Natural selection" determining the survival of the functionally efficient, and inheritable variability bringing about changes in function and the structure related thereto—these are the corner-stones of Darwinism, and nothing has transpired which can shake them. Darwin regarded "conditions of life" *i. e.* environment as *the* cause of variability, and he conceived of the environment as acting in two ways, *viz.* (1) indirectly by inducing a general plasticity, and (2) directly by alteration of habits and consequent modification of structure, and the inheritance of these.

"The progress of research has thrown considerable doubt upon the action of the first cause; but Darwin's belief in the second cause has been vindicated; and it is seen to be the key to the riddle of evolution. In his great book to which the *Origin of Species* was intended to be an introduction, *Variation of Animals and Plants under Domestication*, Darwin introduced his theory of Pangenesis to explain inherited variability. This theory, which has been ridiculed as altogether fanciful, supposed that "gemmules" were produced by every part of the body and thrown into the circulation and accumulated in the germ-cells, and so alterations of structure caused by the environment were handed on to the next generation. If we substitute for the word "gemmule" the word "hormone" is not this theory amply justified by the most recent work?

Kammerer, indeed, has expressly accepted this theory as giving an explanation of his own results.

"Doubtless Darwin was mistaken in drawing too close a parallel between the monstrosities of domesticated breeds and the adaptional peculiarities of wild races exposed to the fierce struggle for existence; but nothing would have horrified him more than the idea that every detail of the argument set forth in the *Origin of Species* should be regarded as the last word on a subject of which, as he himself saw, our knowledge was only beginning."

METHODS OF EVOLUTION. By Duerden (J. E.); and PROF. DUERDEN ON EVOLUTION. By Regan (C. Tate)—*Science Progress*, 1924, No. 72, 556–564 and 565–566 respectively.

Professor Duerden's paper is an able and interesting biological presentation of the difficulties in current notions of evolution, with a leaning towards the theory of discontinued variations of germinal origin; Dr. Regan's article is a pointed criticism of this position.

Prof. Duerden discusses the subjects: The Basis of Homology; Discontinuity of Retrogressive changes; Transmission of Acquired Characters; Orthogenesis; and Fixity and Persistency of Vestigial Structures. Dr. Regan shows the impossibility of generalizing from some of the adduced evidence.

THE DARWINIAN THEORY. By Fisher (R. A.) and E. W. MacBride—*Science Progress*, 1923, XVIII, No. 70, 289–291.

A breezy, interesting interchange of opinions between a biometrist and a biologist, in which the latter appears to have some advantage. There are several statements by the latter that deserve attention:

"It was tacitly assumed by Darwin that differences between members of the same family, brood and litter were inheritable. The pure-line experiments were devised in order to test this assumption; and the answer that they have uniformly given is that the assumption is incorrect. To attempt to maintain, on the ground of the mathematical manipulation of human statistics, that small "mutations" and excess and defect do nevertheless occur in sufficient numbers to account for the whole process of evolution is thoroughly unscientific. . . There is every reason to believe that the racial characters have been slowly acquired during a struggle extending over many thousands of years with the forces of Nature in the region in which each race was evolved, and that the characters are examples of functional evolution or the "inheritance of environmental response."

As to inheritable differences in stature, "Our people are a mixture of three different races: the Nordic, the Alpine and the Mediterranean. Each race has its own normal stature, which is a racial characteristic. These races have been intercrossing in the most complicated fashion for the last 2,000 years; probably the majority of individuals are blends in different proportions of all three. Is it any wonder, therefore, that these various inheritable tendencies in stature exist?"

Concerning Morgan's mutations Professor MacBride's opinion is one and all "are pathological in character and have no analogy with the differences between natural races and species. No one denies for a moment that these pathological varians mendelise beautifully when crossed with the type, but I strongly suspect that the phrase "multiple factors" could advantageously be replaced by "differing degrees of damage"...Mathematicians can render invaluable help to biology, as they can to other sciences, when they deal with data which have been sorted and prepared for them by the specialists in that science; but when they attempt to draw conclusions from unanalysed data in subjects which are unfamiliar to them, their efforts only result in obscurity and error."

Further discussion of the subject is carried on by the two authors in the *Science Progress* of January, 1924, 466–'9, and there are additional notes of interest by A. G. Thacker (469–70).

Some Aspects of the Relation of Species to Their Environment. By Hoyt (W. D.)—*Science*, 1923, LVIII, No. 1509, 432–434.

"Whether the environment can or can not produce new characters within a species, altering its inherent capacities, is still open to question. But, however this may be, we cannot doubt that our species are what they are partly because of the molding action of the environment; and a true interpretation of the evidence shows, I believe, that in many cases, the external conditions affect the germ plasm as well as the body material and consequently have their effects shown in a smaller or larger number of succeeding generations."

The Work of Tornier as Affording a Possible Explanation of the Causes of Mutations. By MacBride (E. W.)—*The Eug. Rev.*, 1924, XV, No. 4, 545–555.

A discussion of Tornier's and Milewski's experiments on animals resulting in the production through unfavorable environment of more or less inheritable variations. "Tornier's work suggests strongly that bad conditions during the period of conception and the early phases of development may be the original cause of the degenerative mutants in man, including under that head not only mental defect, but haemophilia, night-blindness, color-blindness etc. But the important fact is that, however caused, the plasma-weakness is handed on to posterity... Tornier's work has further a great interest for the student of evolution. That 'mendelizing mutations' had nothing to do with evolution, and have not formed the raw material on which natural selection has acted, is a conclusion to which those best qualified to judge of the evolutionary history of animals—palaeontologists, embryologists and systematists—had independently arrived...That evolution has been brought about by the inheritance of habits, and of the structures resulting from them, is the view to which the best students of life, past and present, have been coming nearer; they have hesitated to enunciate it clearly on account of the dogmatic assertion of Weismannian and Mendelian "geneticists" that the inheritance of acquired characters is impossible. But irrefragable proof to the contrary has now been obtained, so that we may now freely avail ourselves of what even Weismann admitted to be the "easiest" method of explaining evolution. If, however, we do this we can then analyse heredity into two factors. . .we have the *intensity of developmental energy* defects in which give rise to 'mutations,' and we have the inheritance of specific habits which, using the word in a broad sense, may be defined as memory. It is this factor which has produced evolution."

DO THE CHARACTERISTICS OF PREHISTORIC HUMAN REMAINS IMPLY A COMMON ANCESTRY FOR MAN AND APES? By Wallis (Wilson D.)—*The Am. Naturalist*, 1925, LIX, 62–69.

"A review of the similarities in structure, in blood and in use of the limbs, points to the apes as man's nearest relatives in the animal kingdom, his first cousins, if he has any. That some creature is his nearest relative is a conclusion to which we are driven by a consideration of the facts of zoological life." But of itself the increasing resemblance of man to apes as we go back in time would not necessarily imply simian ancestry. "Our findings mean, possibly, nothing more than that the human and the simian type, respectively, have been relatively fixed for a much longer period than it has been our custom to regard them." Regrettably the author is content to stop with his views.

THE EVOLUTIONARY HISTORY OF THE VERTEBRATE LIMB. By Kerr (J. Graham)—*Science Progress*, 1923, XVIII, No. 70, 257–266.

After discussing previous theories (the gill septum and the lateral fin hypotheses), the author comes out strongly for the external gill theory. The external gills are peculiar breathing organs projecting from the branchial arches on the sides of the body behind the head in many Elasmobranchs, a few Teleosts and the larval stages of many Amphibia. "The external gill theory frees vertebrate morphology once for all from an unpleasant bugbear in the form of the problem of correlating the various skeletal elements of the pentadactyl limb with those of the paired fin of the fish. Morphologists, dominated by the crude generalization that land animals have evolved from aquatic, have found themselves saddled with the belief that the tetrapod limb is necessarily an evolutionary derivative of the paired fin, and accordingly have had to attempt to determine the homologies between the skeletal elements in the two cases. How thoroughly unsatisfactory these attempts have been is realised by most of those who have troubled to go into the matter critically."

THE EVOLUTION OF THE FUNCTIONS OF BLOOD. By Needham (N. J. T. M.)—*Science Progress*, 1923, XVIII, No. 69, 97–107.

An interesting discussion, probably the first of its nature, on the evolution of blood and its functions. It deals particularly with the red corpuscle and its pigment. Definite conclusions cannot yet be formulated.

Die angeblichen Ähnlichkeiten zwischen fossilen Hominiden und den Hylobatiden. By Remane (A.)—*Anthrop. Anz.*, 1924, Jhrg. I, H. 3, 144–146.

A critique of E. Werth's (Der fossile Mensch, 1921) views regarding supposed similarities of the *Hominidae* and the *Hylobatidae*. In the writer's opinion the notion of such similarities is partly erroneous, while in part it is merely a question of convergences. "All need of referring the *Hominidae* direct to the *Hylobatidae* with an elimination of the *Simiidae* is therefore unjustified by the fossil finds, besides which the presence in the Pithecanthropus of the frontal sinuses shows clearly the kinship of the latter to the chimpanzee-gorilla-man group."

FOSSIL APES AND HUMAN PRECURSORS

On Three Incomplete Anthropoid Jaws from the Siwaliks, India. By Brown (Barnum), W. K. Gregory and Milo Hellman. *Am. Museum Novitates*, N. Y., 1924, No. 130.

A description of three valuable though incomplete fossil anthropoid jaws discovered by Mr. Brown in the "Lower, Middle and Upper Middle Siwalik horizons respectively. One of these jaws has the symphyseal region and the premolars in excellent preservation, and the other two have the cheek teeth nearly perfect, so that taken together they constitute, a significant addition to our kowledge of the rare Siwalik anthropoids. The specimens, coming from three well-separated horizons, represent as many successive stages in the differentiation of the premolars from a simpler, more compressed form toward a more bicuspid-like condition."

The specimens are named respectively *Dryopithecus pilgrimi*, *D. cautleyi*, and *D. (?) frickae*.

These jaws, in the opinion of the authors, are "of exceptional interest, because of the additional evidence they afford for the close kinship of the Indian anthropoids not only to the existing great apes but even to the forerunners of man." In connection with this last important statement there is felt a need of further explanation.

Australopithecus Africanus.—At the suggestion of Dr. Hrdlička, the Science Service of the National Research Council, has asked Professor Dart, the discoverer of the recently reported important Primate remains in South Africa, for details of the discovery, and the following cable was received in response:

The *Australopithecus Africanus* consists of two fragments. The endocranial brain cast is complete. The face was embedded in the limestone of an old cavern completely filled with stratified lime-infiltrated sand. The cave is in the dolomitic Kaap Plateau, near the locality of Taungs, Kalahari, Bechuanaland. The skull was dolichocephalic. The face was leptoprosopic. The remains are those of a juvenile subject with first permanent molars erupted [age probably somewhere about 4 years]. The brain was a little larger than that of an adult chimpanzee. The *sulcus lunatus* of the brain is in a position approaching human.

The brain shows marked tempro-parieto-occipital expansion [expansion of the posterior two-thirds of the cerebrum]. There is an absence of the pre-rolandic and post-rolandic flattening.

The supra-orbital ridges on the skull are [still] absent. The orbits are rounded. The nasal bones terminate distally above the line connecting the lower margins of the orbits. The upper dental arch is parabolic in shape. The canines are small; their diastema [space in front of the canines] measures 3 mm. There is no diastema about the canines of the lower jaw. The lower jaw resembles anteriorly the Heidelberg jaw. It has no simian shelf. Its canines are small and in line with asymmetrical vertical incisors.

The *foramen magnum* is well forward.

The specimen is diagnosed as a manlike ape, of a new family: the *Homosimiidae.*

Since the above was received, interesting account and antique of the find have appeared in *Nature*, Feb. 7 and 14.

On the Principal Characters of the Cranium and the Brain, the Mandible and Teeth of Pithecanthropus Erectus. By Dubois (Eugene)—*Proc. Kön. Akad. & Wetemschappen Amsterdam*, 1924, XXVII, Nos. 3 and 4, 14 pp.

After a long preparation, part of which consisted in a successful cleaning of the inside of the skull cap as well as of the frontal sinuses of his precious find, Professor Dubois presents herewith in an abbreviated form his utlimate conclusions regarding the Pithecanthropus. A detailed illustrated memoir on the subject is to be published in the near future (see next item). As the new information which includes notes on what the author regards as remains of a second Pithecanthropus, is of much importance, and as Professor Dubois' opinions deserve the closest attention of all students of man's origin, it will be useful to quote here more fully than usual from the article. the more so as this appears in a publication that is not generally available.

"The remains are in a state of perfect mineralization. . . Their specific gravity, like that of the bones of the other mammals which were dug up with them at Trinil (which bones have the same outward appearance), has risen to about 2.7, an increase of about 35% compared with dry fresh bony substance." Only traces of organic matter remain. The bones are of chocolate brown color. "According to the analysis of the late Prof. J. M. van Bemmelen both phosphate and carbonate of calcium have taken the place of the ossein, and they contain fluorium in the quantity which, according to Ad. Carnot's investigations, is characteristic of fossil bones of the Pliocene. The particular pseudomorphism known as mineralization, petrifaction or fossilization, has very strongly affected the bones of Trinil. Their great antiquity appears also from this that calcite and pyrites have crystallized in many cavities and canals in the bones. . . These physical and chemical properties with the character of the mammal fauna, stamp the remains of Pithecanthropus as pliocene. . . "Decisive are here the morphological characters of Pithecanthropus. . .

"The morphological investigation of the cranium is restricted or hampered by three circumstances: first that only the upper part of the calvaria as calotte or calvarium has been preserved; secondly that the outer surface has been greatly corroded by sulphuric acid, formed from pyrites in the volcanic tufa; thirdly that the cranium has been deformed in a natural way (through trigonocephalism, though in a small degree). These circumstances have not seldom led to erroneous conclusions in the study of the plaster cast. At the fossil calvarium itself at least the principal morphological characters can be clearly observed.

"At the plaster cast it cannot be seen in every detail to what extension the calvaria has been preserved, especially not at the frontal border and in the temporal region. The situation of the glabella-point and of the asterion, and in approximation of missing parts, as the metus acusticus, the processus mastoideus, can therefore only be determined at the fossil itself. In virtue of this and on account of some loss of substance at the inion, the real maximum cranial length may be put at 184 mm., though the directly measurable length is only 180.5 mm.

"Particularly, however, about the original state of the external surface of the calvaria the fossil alone can give an accurate idea. It must have been smooth on the whole, about as at the skull of a small gibbon species, because there are nowhere traces present of distinct ridges, still less of crests, except the apparently perfectly gibbonlike crista supramastoidea. Between intact spots, corresponding to which also the endocranial cavity reaches it greatest width, the greatest cranial breadth, 131 mm., can be measured. Hence the length-breadth index is 71.2. It may also be mentioned here that the calvarial height above the glabella-inion line (Schwalbe's "Calottenhöhe") is 61 mm.

"On account of much loss of substance on the left side the post-orbital breadth (constriction) can also only be judged from the fossil remain itself. It is 87 mm., the original (true) breadth must, however, have been at least 91 mm. The fronto-biorbital index (Schwalbe), i. e. its ratio to the external orbital facial breadth, which latter I estimate at 115 mm. as a minimum, is at most 79. In a cranium of a Hylobates agilis resembling that of Pithecanthropus in many respects, this index is 78.4. The post-orbital length index (Schwalbe) is 25.5, the distance between the orbital constriction and the bregma-transversal being 47 mm. This index is 25 at the same cranium of Hylobates agilis. The whole pre-cerebral part of the frontal bone is hylobatoid, like the rest. . .

"The shortest distance between the two temporal lines was probably 85 mm., the ratio to the cranial breadth is the same as that of the small gibbon species.

"It is seen that to the sagittal arc-length of the cranial vault the frontal bone contributes 100 mm., the parietal bone 90 mm., and the upper part of the tabular portion of the occipital bone 45 mm. This is an entirely different ratio between the two first divisions of the vault from that in Homo sapiens and Homo neandertalensis, where the parietal arc is longer than, or equally long as, the frontal arc. In the Hylobatidae, on the other hand, the parietal bone is much shorter in comparison with the frontal arc, than in Pithecanthropus. The latter's fronto-parietal index is 90, that of the large gibbon genus, Symphalangus, 53 on an average, and that of the small gibbon species has an average value of 42...

"The lower part of the tabular portion of the occipital bone, the pars nuchalis, bends downwards and forwards at an apparently not very obtuse angle. But this obtuse angle was much larger at the intact skull, because at the fossil cavalrium the loss of substance greatly increases towards the edge of the fragment, so that this edge only still consists in the knife-like lamina interna. In the intact state of the skull Pithecanthropus resembled the Hylobatidae in the steepness of the planum nuchale.

"The torus occipitalis presents the closest resemblance with that of Symphalangus syndactylus.

"In the view of the cranial vault from below the very spacious and largely communicating right and left sinus frontales may be recognized in their full width and depth. Together they have a width of 55 mm.; their greatest depth (measured from the front backwards) is 23 mm. The maximum endocranial length between the frontal and the occipital poles amounts to 153 mm. on the left, to 155 mm. on the right side. The maximum endocranial breadth is 124 mm. The apex of the endocranial cavity is above this transversalis, to a height of 58 mm. This transversalis lies about in the transversal plane of the right frontal pole and the upper edge of the right sulcus transversus, to which plane the capacity of the calvarium was measured. Within the whole reach of the frontalis its inner surface shows very strong impressions of the cerebral convolutions, undoubtedly a consequence of premature union of the two halves of the bone. The cerebral impressions and the likewise very strong grooves of the arteria meningea medea are most clearly to be seen at the endocranial cast, reproducing the positive of the cerebral surface. In the reach of the parietalia and of the attached parts of the temporalia there are hardly traces to be seen of the impressiones digitatae and juga cerebralia, with the exception of the jugum sulci centralis and the jugum sulci intraparietalis. There is also a strong jugum sulci lunati, lying immediately behind the sutura lambdoidea. (In the Hylobatidae and the Chimpanzee this jugum lies as a rule immediately before the suture.)

"Of that process in the cranial cavity chiefly formed by the lesser wing of the sphenoid, which in the brain corresponds to the fissura Sylvii, a considerable piece has been preserved especially on the right side. Present is also a powerful crista occipitalis interna, which possession distinguishes Pithecanthropus from the Hylobatidae, which have there a wide groove, as impression of their round, barer vermis cerebelli, and agrees with the large Simiidae and Man. The endinion lies 26 mm. lower than the inion externum. The sulcus sagittalis, the torcular Herophili, and the right sulcus transversus are wide and deep. With respect to the latter sulcus the parieto-mastoid suture lies exactly the same as in Hylobates. Also as regards the situation of the internal asterion Pithecanthropus agrees entirely with Hylobates. For the postasterial index (the ratio of the distance between the astrion and the occipital pole and the endocranial length) I find 15.5 in Pithecanthropus, 15.8 in Hylobates, and a mean value of 24 in human skulls of different races.

"The form of the skull of Pithecanthropus is on the whole not human; nor is it a transition of any type of manlike apes to the human type...

"Nor can the skull, however, have belonged to an Anthropoid Ape, because the relatively very large skull as regards shape presents a close, nay striking resemblance with the skull of a small Hylobates-species, the smallest of the Anthropoid Apes, whereas judging not only from the femur and the molar teeth, but also from the skull itself, Pithecanthropus must have surpassed the size of a large Chimpanzee, and very much that of a middle-sized man...

"The volume of the space in which the greater part of the cerebral hemispheres was contained, can be accurately measured with water up to a certain morphological limit[1] in the calvarium, this having been made watertight. A volume was found of 570 cc.. In order to calculate the whole capacity from this part, the ratio of morphologically the same part to the whole capacity was determined in skulls of apes which resemble the skull of Pithecanthropus as much as possible. In general this ratio lies in skulls of apes very near 1:1.6. In human skulls of different races 1:1.4 was found on an average. In the skull of a Hylobates agilis, the shape and structure of which closely resembles the fossil skull, this ratio is 1:1.56. Taking small morphological differences into account, as particularly the much greater impressions which the orbitae make in that upper cranial part in Hylobates, the cranial capacity of Pithecanthropus can be calculated in approximation from this ratio at 900 c.c. This calculated capacity can certainly not depart greatly from reality. Besides, it may be considered to be about the mean of the species, as will appear further below. It may be assumed that with equal body weight Pithecanthropus possessed double the brain quantity of the Anthropoid Apes.

"In its side view (norma lateralis) the ENDOCRANIAL CAST presents a striking resemblance with the endocranial cast of a small Hylobates-species reproduced at the same size; thus also in the steep position of the endocranial planum nuchale. The only difference of importance consists in the much smaller impression which the orbitae make in the cerebral hemispheres than in Hylobates (where there is present a very pronounced "bec encéphalique" = rostrum orbitale, ethmoidale, or cerebrale), as a consequence partly (about ¼ of the calculated surface dimension) of the circumstance discussed before, that with increasing body-weight the eye, according to a definite law, is enlarged less than the brain, but especially (for about ¾ of the calculated surface dimension) that in Pithecanthropus the latter has double the volume of the brain of an Anthropoid Ape of the same bulk. Accordingly this difference does not entail another brain development.

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[1] The transversal plane described in these Proceedings Vol. xxiii, (1921), p 1272.

"There is on the other hand a great difference—and a difference of great importance—between the profile of the endocranial cast and that of the Neandertal Man of La Chapelle-aux-Saints. Though in consequence of its comparatively small height this seems more simian than that of Homo sapiens, also this human brain profile is seen to rise considerably above that of Pithecanthropus and Hylobates. From the front to the occiput, but the greatest difference, both in Homo neandertalensis and in Homo sapiens, is in the parietal region, near which apex the upper end of the sulcus centralis is situated. Hence the human brain may be called MACROTACTILE in the highest degree, as occupying the highest stage of the development on the tactilomotive basis of the central gyri of the cerebral hemispheres characteristic of the Primates. Undoubtedly because the hand, the unequalled tactile organ and the most efficacious instrument of the entire animal world, reaches its highest perfection in man . . .

"In Pithecanthropus the bregma-point lies about 12 mm. before the sulcus centralis of the brain, but still considerably behind the sulcus praecentralis superior. Just as in the Hylobatidae also the upper part of the coronal suture lies *behind* the sulcus praecentralis superior, in contrast with the large Anthopoid Apes and with Man, in which latter the crown suture is situated on an average from 2 to 3 cm. *before* the sulcus praecentralis . . .

"In the frontal region of the cerebral hemispheres the gyri can be very clearly distinguished at the endocranial cast, as was already said above. They are slightly less simple on the left side than on the right where, they have also been preserved over a somewhat larger extent. For an immediate orientation the central and precentral sulci and the Sylvaian fissure can at once be easily recognized.

"Most conspicuous, to the front, is, on the right side, the SULCUS FRONTALIS INFERIOR, as clear and unmistakable as in any human hemisphere, but in the simplest form, which it presents shortly before birth.

"It has the shape of a ɜ lying almost on its side, the lower half of which encompasses a strong front branch of the Sylvian fissure. On comparison of this endocranial cast with endocranial casts of Chimpanzee, Gorilla, and Gibbons the validity of the interpretation of Chudzinsky, Eberstaller, Hervé, and Waldeyer appears with the greatest clearness, according to which the sulcus frontalis inferior of Man is homologous with the sulcus fronto-orbitalis of the Apes and the microcephalics, and then also the sulcus principalis or rectus of the Apes homologous with the sulcus frontalis medius plus fronto-marginalis (Wernicke) of Man. In consequence of the greater increase of the brain volume compared with the eye, the sulcus fronto-orbitalis is seen to shift from the orbital to the lateral surface of the hemisphere from Hylobates to Chimpanzee (and Gorilla) for a great part, and to Pithecanthropus entirely. The cerebral convolution lying under and behind the sulcus fronto-orbitalis of the Apes is, therefore, the gyrus frontalis inferior. The conclusive establishment of these homologies is certainly the most important fact taught us by the unequalled endocranial cast of the Trinil calvarium.

We meet, therefore, already with perfectly human forms in the frontal cerebral gyri of Pithecanthropus, and these forms are fundamentally the same as those possessed by the Hylobatidae, which we may admit to resemble the general ancestor of the Simiidae or Manlike Apes, notwithstanding their specialized features. The fundamental plan of the human brain thus evidently dates from the primitive simian one.

"The two knees or genua of the sulcus centralis, so characteristic of Manlike Apes and constantly occurring, the upper or cruro-brachial and the lower or brachio-facial genu, physiological cortex boundaries according to Sherrington, are also met with in Pithecanthropus... For the rest the brain of Pithecanthropus is not distinguished qualitatively, only quantitatively, from that of the Anthropoid Apes...

"It seems to me that it is evident, at least, from all this that Man and Pithecanthropus, both descend from a common primitive Simian ancestor. From this among the living species, the Hylobatidae, though greatly differentiated by their long arms and sabre-shaped canines, depart least, several fossil Simiidae still less.

"Also through his MANDIBLE AND TEETH Pithecanthropus deviated less from this common stock type than the three living Gigantanthropoidea and the Hylobatidae.

"Besides the calvarium and the left femur, three different teeth were dug up at Trinil, and nearly a year before the discovery there of the first fossil remain of Pithecanthropus (the hindmost right upper molaris), a MANDIBULAR FRAGMENT, a small piece on the right of the symphysis, was found in the same Kendeng-layers, but at 40 km. distance on the E.S.E. of Trinil, namely at Kedung Brubus, among other fossil remains of the Kendeng-fauna. Its specific gravity is the same as that of the teeth and the other remains of Pithecanthropus. A brief description of the mandibular fragment appeared at Batavia in 1891, in the "Verslag van het Mijnwezen," and I mentioned it, in a few words, in the "Natuurkundig Tijdschrift voor Nederlandsch-Indië" of the same year. I then considered it a remain of a not exactly determinable human species "of another and probably lower type" than those existing and the extinct European diluvial species. This particularly on the ground of a peculiarity in connection with the place of attachment of the digastric muscle.

"The mandibular fragment is a scalene-triangular piece of the corpus mandibulae, with as basis 36 mm. (measured rectilinearly) of the lower border, immediately on the right of the symphysis. The apex is formed by the root of the anterior praemolar tooth, which root has been preserved for the greater part. It is there 30 mm. high. There further is preserved the back half of the flat alveolus of the caninus with its root point and part of the front plane of the alveolus of the posterior praemolar tooth, under which is situated the front edge of the foramen mentale, 12 mm. above the sharp lower border. In its full thickness the corpus mandibulae has only remained preserved at the septum of the alveoli of the caninus and the anterior praemolar tooth.

"I now ascribe also this mandibular fragment to Pithecanthropus erectus, because what the teeth teach us is quite corroborated by the morphological characters of this small, but all the same very significant piece of the mandible. The three teeth of Trinil are the upper left second and right third molar tooth, and the lower left anterior premolar tooth. The root of the lower anterior premolar tooth, which has remained preserved in the mandible fragment, closely resembles the root of that tooth of Trinil, and the alveolus still present in front of it, with the root-point of the canine tooth, betrays comparatively small canini, a caninus of the maxilla in keeping with this short premolar crown of the mandible. In view of this it is highly probable that the mandible fragment of Kedung Brubus derives from (another individual of) Pithecanthropus erectus, an at any rate rare species of the Kendeng-fauna.

"The jaw and the teeth appear to have been almost perfectly human in their front part, particularly in the shape of the symphysis and the lower anterior premolar tooth and the canini, all of which differ so characteristically from those of the Manlike Apes. Crown and root of the premolar tooth are mesio-distally narrow, and the root, which has a double formation, is only divided near the point. Also the alveolus of the lower caninus is flattened in the said direction.

"Very remarkable is at the mandible fragment the extensive, broad, and long area of attachment of the digastric muscle, which makes the under part of the bone angular over a great length (as far as past m^2). This attachment of the digastric muscle which, as in the gibbons, extends far backward, is incompatible with a function of the tongue as an organ of speech. The muscle may, indeed, have been particularly powerful (much stronger in proportion to the size of the body than in the gibbons), because it had to bear a comparatively greater weight, on account of the erect attitude of Pithecanthropus.

"Very different from that of the Manlike Apes, the symphysis must have been quite human. In the large Anthropoid Apes a plane applied at right angles to the alveolar line, between the caninus and the anterior premolar, always cuts the corpus mandibulae at a considerable distance before the back edge of the symphysis; in the small gibbon species it just strikes the back edge. In the mandibles of Mauer, Spy, and La-Naulette, as well as in modern Man, on the contrary, this plane remains about 1 cm. behind the symphysis. The plane in question generally passes right through the septum of the alveoli of the teeth mentioned, and also in our fossil mandibular fragment this plane remained far (7 mm. according to estimation) behind the symphysis.

"The root of the ANTERIOR PREMOLAR tooth in this fossil is broad, bucco-lingually 8.4 mm., and flattened in mesio-distal direction to 5.0 mm. Hence it has about the same dimensions as the root of the homonymous tooth of Trinil: 8.1 and 4.2 mm. Like this, it is composed of two root elements placed almost transversally, to be recognized by the two canals. The two teeth were evidently of the same type.

"This tooth of Trinil was very human, as also appears from the diameters of the crown: 8.2 mm. bucco-lingual, 7.0 mm. mesio-distal, breadth index 117. It is undoubtedly an *anterior* premolar tooth, for the buccal cusp is much larger than the lingual one, hardly deserving the name of cusp, which feature makes the masticatory surface oblique, the buccal surface is strongly bent inward, bulging outward and much higher than the lingual surface; besides the middle crista is of a type only met with at anterior praemolar teeth of Anthropoids. In front and at the back the crown presents a facet of contact, with the canine tooth and the posterior premolar tooth of the lower jaw, and at the upper edge of the buccal surface a facet of wear with the caninus of the upper jaw. The flat root of this tooth consists of a front-outer and a back-inner element. At the back-side they are separated only at the point of the former (the other point is broken off), over a length of 3.6 mm., but at the front side the disjunction of the root extends, as a deep fissure, 8 mm. more towards the crown. The total length of the front-outer root-element is 20.1 mm. The two roots of the homonymous tooth of the Anthopoid Apes. which are entirely or for the greater part separated and placed almost perfectly behind each other, are found here, as it were, from front backwards pressed almost crosswise and grown together.

"The two UPPER MOLAR TEETH of Trinil, both with a triple disposition of the buccal roots, which have, however, been fused, evidently derive from one and the same individual. The rugosity of the crown of m^3 is much greater than in the Orang-utan, though in the shape of its crown this tooth presents a striking resemblance with some Orang-utan teeth which I collected in caves in Central Sumatra. Besides a shape of crown as of m^2 is frequently met with in the Orang-utan. The slight development in both crowns of the hindmost buccal cusp, and the strong divergence of the roots may be in connection with the trigonocephalism of the cranium, which promoted the growth of the teeth in transversal direction above that in sagittal direction. The brachycephalism of the Orang-utan and the trigonocephalism of this individual Pithecanthropus have here the same result. For the rest, the circumstance that the three teeth were found at Trinil in exactly the same plane of the andesite tufa with and comparatively near other remains of Pithecanthropus, renders the probability that they originate from one individual almost a certainty.

"The crowns of the molar teeth have these measures, (mm.):

	bucco-lingual	mesio-distal	breadth index
m^2	13.8	12.0	115.0
m^2	15.3	11.3	135.4

"As to size, m^3 is greatly exceeded by some Orang-utan teeth from caves of Central Sumatra. Two of these attain bucco-lingually 18.7 and 20.2 mm. and mesio-distally 14.0 and 15.5 mm.; an m^3 thus reaches 19.0 and 17.7 mm.

"The length of the two roots of the two molar teeth is as follows: the buccal of m^2 13 mm. and of m^3 14 mm., the lingual of m^2 12 mm. and of m^3 12.5 mm. They diverge greatly (the lingual deviates most from the vertical); between the outside of the points the distance is 16.5 mm. in m^2 and 18.0 mm. in m^3. The lingual roots are simple, the buccal ones on the other hand are composed, as stated above, in both teeth, of *three* fused elements: two outer (buccal) root elements, and one at the inside of the foremost of the latter. In Man as well as in the Anthropoid Apes there are found as a rule one lingual and two buccal roots. The fusion of the two buccal roots points again to the mesiodistal shortening of the dentition, the incipient splitting up of the mesiobuccal root to the broadening in lingual-buccal direction. These are certainly individual characters, which establish that the two molar teeth belong individually together. The peculiar individual growth of the two teeth is, as was already said above, evidently in connection with the trigonocephalism, which caused the cranium to widen towards the bottom in its front half. The direction of the roots backwards may, possibly, have the same meaning, for the dental root grows towards the point, and there was more room towards the back.

"The approach of the mandible and the teeth, as also of the femur, to the human type, and the large cranial capacity, added to considerations on the brain-quantities in nearly allied mammalian genera, all this leads me to the conclusion that Pithecanthropus should be considered as a member, but a distinct genus, of the family of the Hominidae."

FIGURES OF THE CALVARIUM AND ENDOCRANIAL CAST, A FRAGMENT OF THE MANDIBLE AND THREE TEETH OF PITHECANTHROPUS ERECTUS. By Dubois (Eugene)—*Proc. Könink. Akad. Wetenschap.*, Amsterdam, 1924, XXVII, Nos. 5 and 6, 459–464, Pl. I–XI.

An important complement to the preceding. There are 11 excellent plates of the now thoroughly cleansed skull, the intracranial cast, the teeth and the fragment of the lower jaw; while the legends give some further details of value.

EARLY MAN

FOSSIL MAN IN SPAIN. By Obermaier (Hugo)—8°. Transl. by Christine D. Matthews from EL HOMBRE FÓSIL issued in 1916, with author's additions and corrections up to 1922. (The Hispanic Society of America), 1924, 495 pp.+XXVIII.

The translator's title of the volume is misleading, because the study is not confined to Spain but covers the entire known field, though less thoroughly than MacCurdy's more recent two volumes, entitled HUMAN ORIGINS.

The author presents frequent original data and opinion from his rich and widespread researches in most of the important sites in Europe. Especially has he brought a clearer set-up of the present state of knowledge on the finds in the Iberian Peninsula. The following subjects are considered:—Tertiary man and eoliths, the glacial epoch and its plants and animals, early and late palaeolithic industries, and their geologic chronology, Iberian peninsula in the glacial period, palaeolithic art, fossil man, and the transition from palaeolithic to neolithic culture.

After discussing the eolithic problem, it is left with these words:—"The result of careful and unprejudiced investigation goes no further than to prove that forces dynamic and geologic are sufficient satisfactorily to explain the natural and accidental formation of eoliths." None of the other subjects is given this sort of a knockout blow, but mostly they are left with strong and constructive findings. If early man, or their precursors, did not make the particular "eoliths" studied by the present-day archaeologist, they made stone implements equally crude and simple before they possessed the skill and the intelligence necessary to make the slightly more developed Pre-Chellean implements.

The discussions and maps of geographic migrations and spread of cultures are helpful. The book is well illustrated and makes a noteworthy contribution in its many pictures of prehistoric man. These pictures, mostly from Spain, show such interesting phases of life as hunting, tracking, trapping, honey gathering, warfare, mimetic and other types of dancing, types of war and hunting weapons, women's clothing, head-dresses and body adornments of men, and suggest types of physique. The book contains a sufficient classified bibliography for the University student, but enough is omitted to lure on the advanced student for research among published sources. It is a valuable contribution and addition to an already respectable shelf of volumes on the general subject of palaeolithic man, and it makes much clearer the relationship of the Iberian peninsula to the remainder of Europe.

A. E. Jenks

Ancient Hunters and Their Modern Representatives. By Sollas (W. J.)—New York, 1924, 3d rev. ed., 689 pp., 367 figs. (The Macmillan Co., $6.50.)

This is a well known and in many respects deserving work on early man in Europe. Since the second edition appeared (1915), "the progress of discovery has been so rapid as to render necessary many additions and complete revision of the work. The general acceptance of the presence of some member of the human family in Europe at an age far more remote than has hitherto been admitted has completely changed our perspective. The chapters on the Antiquity of Man have therefore been almost entirely rewritten. An account is given of the work of Professor Depéret which enables us to determine with greater certainty and precision the relative age of deposits containing human remains... The work has been brought as nearly as possible up to date, and numerous additional illustrations accompany the text." The book deals with the following subjects:

> The Great Ice Age; Antiquity of Man; Eoliths; Extinct Hunters, The Tasmanians; Lower Palaeolithic. Chellean and Acheulean Ages; Lower Palaeolithic. Mousterian Age; The Australian Aborigines; The Aurignacian Age; The Bushmen; The Solutrean Age; Magdalenian Man; The Eskimo; The Azilian Age; Chronology; Chronological Table and Index.

A critical review of the book would require more space than is available. It must suffice to say that there is much in it that is good, though there are also, as could hardly be otherwise in a work of this scope, points open to criticism. One of the plainest of these is the accentuation (p. 584) of the old illusion about the direct and decisive Eskimo affinities of the Chancelade skeleton. For the author "the osteological characters of the Eskimo, which are of a very special kind, are repeated by the Chancelade skeleton so completely as to leave no reasonable doubt that it represents the remains of a veritable Eskimo, who lived in Southern France during the Magdalenian age." The reviewer, who has an ample acquaintance with Eskimo crania and bones, had an opportunity a little over a year ago to personally examine this skeleton and in his opinion the above statement is not sustainable.

OUR FORERUNNERS: A STUDY OF PALAEOLITHIC MAN'S CIVILISATIONS IN WESTERN EUROPE AND THE MEDITERRANEAN BASIN. By Burkitt (M. C.)—12mo, N. Y. and Lond., Home University Series, No. 104, 1924.

A delightful little book, giving in a popular and yet very instructive way the essentials about prehistoric man.

Contents:

Conditions, Geological and Otherwise; Tools; Earliest Human Cultures; The Mousterian Period; Upper Palaeolithic Cultures; The Transitional Period; Prehistoric Human Remains; Palaeolithic Art; Motives for the Art; with Bibliography and Index.

THE ANTIQUITY OF MAN. By Keith (Arthur)—London, 1925, 2 vols., pp. i–xxiii, 753, 266 illustr's. (Williams & Norgate, 25/—).

Two volumes as interestingly written as everything from the pen of the author. This second edition of his work is a thorough recast of the first, with important additions and corrections. The author is big enough frankly to acknowledge more than one previous error or misinformation. The scope of the work will best be seen from the "Contents:"

Volume I—A Neolithic Community of Kent; Neolithic Communities in Crete, Egypt and Babylonia; The People of the Submerged Forest; The Discovery of Pre-Neolithic Man; Continental Types of Man during the Later Palaeolithic Periods; Englishmen of the Later Palaeolithic Periods; Further Examples of Later Palaeolithic Men in England; The Mousterian Period in England and the Men of that Period in France; The Distribution of Neanderthal Man in Europe; The Anatomical Peculiarities of Neanderthal Man; Men of the Acheulean Period; Galley-Hill Man; Pre-Mousterian Man in France and Italy; Ancient Man in East Anglia; Heidelberg Man; Is *Homo Sapiens* an Ancient Type?; Malta and the Land-Bridge to Africa; Ancient Man in South Africa. Volume II—Rhodesian Man; The Face and Status of Rhodesian Man; Pithecanthropus—The Java Man; The Wadjak and Talgai Men; The Antiquity of Men in North America; Early South Americans; The Discovery of the Piltdown Skull; The Antiquity of the Piltdown Race; Eoanthropus Dawsoni; The Difficulties of Reconstruction; Can Fossil Fragments Yield Remarkable Evidence of Man's Evolutionary History?; Head—Ancient and Modern—in Profile; The Brain of Fossil Man; The Piltdown Mandible; Evidence of the Teeth of Fossil Man; Facial Features of Fossil Man; A Chapter of Conclusions; and Index. To the text are added illustrations many of which are originals.

In the Preface the author tells us that while interested like other anthropologists in "the abstract problem of man's origin and antiquity," he is "more directly concerned with the concrete question of the origin and antiquity of men of our own type."

The books themselves are replete with thought and in many respects it is easy to be in agreement with the genial writer. If there are exceptions, they are explainable, there are less of them than in the first edition, and they are milder. The main exceptions are unquestionably to the section dealing with ancient man in America. Professor Keith is still inclined to accept a geological antiquity, even if but a moderate one, for many of the old finds, including even the Calaveras skull notwithstanding what was shown about this by Holmes, Putnam and Merriam. Yet he partly redeems this by the statement (p. 483) that "we have seen no evidence to lead us to suppose that any race preceded the American Indian in the new world." Yet (p. 484), he feels "that human secrets still lie hidden in America." As to Professor Osborn's *Hesperopithecus* (p. 476) "his courage deserves to be vindicated," but on the evidence now available Professor Keith does not think "the Primate nature of *Hesperopithecus* can be upheld."

The author has added a useful chapter "in which an attempt has been made to summarise the evidence relating to man's antiquity in Eastern lands and at the same time to note the kinds of men who occupied them in early days." He has also added notes of late discoveries in England and France, including, possibly prematurely, the recent "Aurignacian" finds at Solutré. He gives full and special description of the Chancelade skeleton, which he regards much more sensibly than some other English writers; and describes the discoveries in Germany, Malta, South Africa (Boskop and Rhodesia), Java, and Australia.

The ever-increasing evidence has compelled Professor Keith to alter his attitude towards many of the major problems of man's evolution. This is particularly the case as to the antiquity of the modern forms of man. As it is, "all experts agree that full-blown modern man made his advent in Europe in the latter third of the Pleistocene period;" as to himself, he has to confess that as evidence accumulates it does not favor his former contention that the modern forms of man were more ancient. "I have expected during these past ten years, that remains of the modern type of man would be found under circumstances which would prove their early Pleistocene age. No discovery of this kind has been made. Nay, one of the discoveries on which I leaned—that of the Ipswich skeleton—has given way. The Ipswich man has fallen headlong down the scale of time from the farthest to the nearest point of the Pleistocene period. The evidence, as it now stands, leads us to believe that between the date to which Galley-Hill man has been assigned and the time which marks the final arrival of the European type, Neanderthal man was in possession of our part of the world . . . Then, other evidence on which I relied to prove the permanency of the modern type—to prove how resistant it is to evolutionary change—has given way." Dr. Keith's belief in the resemblance of Englishmen of the Neolithic period to Englishmen of to-day had also to be moderated.

A remarkable innovation, which calls for serious reflection, is the author's radical reduction of the estimates as to the duration of the Pleistocene and Pliocene periods. In his opinion the archaeological evidence does not permit of any higher estimate for the Pleistocene age than 200,000 years, and if the Cromer beds are not as ancient as was supposed, of which there are some indications, the "Pleistocene period will have to undergo another reduction, becoming little more than 100,000 years." Professor Keith sees only two Pleistocene glaciations in England, but assumes also a late Pliocene glaciation. He has "come to realise that the 'law of uniform or collateral evolution' has a wider significance than I had formerly believed...such a law implies that species descended from a common ancestral stock may assume simultaneously characters which the ancestral stock did not possess." Migration, he believes, "has played only the most minor part in shaping the evolution of man...The more densely populated parts of the world are also the centres of most rapid evolution. We have to presume, until we can prove to the contrary, that each racial type has been evolved in that part of the world where now we find it, and we have to apply this rule not only to living races but to extinct and fossil races of mankind."

Homo fossilis Cordubensis.—Name given to interesting human remains found accidentally by some laborers in January, 1924, in an ancient cave in a southern fold of the Sierra de Córdoba, near the village of Alcolea. The find is reported under the title "La Estación prehistórica de Alcolea" by Srs. A. Carbonell y Trillo-Figueroa, V. de la Puente y Quijano, and A. Rodriguez Diaz, engineers and members of the Academy of Córdova (8°, Córdova, Feb. 1924, 37 pp., 12 fig.). The find was made in excavations for the new aqueduct of Córdova. It consists of the remains of at least nine individuals and of stone implements of the chellean, capsian and neolithic forms mixed together. Portions of a skull lying apart from the other skeletal remains show characteristics which, in the opinion of the authors, stamp it as neanderthaloid and this skull is referred to the *homo fossilis cordubensis*, while the others are regarded as more ancient. The "Alcolea skull," as it is also conveniently named, is represented by a large portion of the vault, a good-sized piece of the lower jaw and a fragment of the upper maxilla. The vault approaches the modern oblong form, but possesses a complete though not heavy supraorbital torus. The symphysis of the lower jaw approaches the vertical, nevertheless the chin is already indicated; the teeth, judging from the illustration, offer nothing very primitive. The skull measures approximately L. 18.8, B. 13.5, Height (not stated which) 12.4, circumference 51.4, antero-posterior arc 31.5, diameter frontal minimum 9.5 cm.

Judging from the description of the finds as well as from the illustrations, there remains, first, a doubt as to the presence of chellean culture. As to the skull, it is an interesting specimen, showing however a transitional and fairly late rather than true neanderthal form.

Lebka Podbabská (The Podbaba Skull)—By Matiegka (J.)—*Anthropologie*, Prague, 1924, II, No. 1, 1–16. (With abstract in French. All the papers printed in this excellent new Journal are provided with ample abstracts in French or English.)

The paper gives a full history and a very good detailed study of the specimen. The author's conclusions are that while a Quaternary age for the skull remains in doubt, morphologically the specimen shows certain transitional or intermediate features between the Neanderthal and recent types.

THE SKULL OF PODKOUMOK. *Russki Antropol. Jur.*, 1922, XII, 92–109. (In Russian; abstr. in French, 238–'9.)

A description of a defective female skull proceeding most probably from the period of the last glaciation in the Caucasus. The specimen presents a neanderthaloid torus and various other primitive characters, together with some more advanced. It is apparently a transitional type though the author classes it with the neanderthal.

NEANDERTHAL REMAINS IN THE CRIMEA.—In the last week of February an important press notice was received from Russia reading as follows:

"Moscow, Feb. 20. Two human skeletons of the Neanderthal type belonging to the Paleolithic age have been discovered in a cave near Simferopol in the Crimea, Prof. Bontish-Osmolowsky, a Russian scientist announced to-day.

While the two skeletons believed to be 50,000 years old, are not anything like the age of the skull of the manlike ape recently discovered by Prof. Dart near Bechuanaland, anthropological authorities here say that the Simferopol finds, taken altogether, throw considerable light on the remote primeval period when man had just escaped from the ape stage and begun to people the recesses of Africa and Asia.

In addition to the human relics found in the cave there were also discovered a number of skeletons of mammoths, dinosaurs, cave hyenas, cave bears and a large variety of stone implements."

As this notice, like the one relating to the recent important find in South Africa, bore evident marks of authenticity, Science Service, at the suggestion of Dr. A. Hrdlička, cabled for further information and received in a few days an answer as follows:

Moscow, March 3.

Professor Bonch-Osmolovski gives the following information about his archaeological researches: The idea that glacial man retreated to the Crimea before the advancing glacial invasion from the north induced me to begin investigations in the Crimea. Systematic explorations were begun in 1923 twenty-five miles from Simferopol, near the village of Kipchak where in a cave called Koush Kvat I found the remains of the mammoth, Siberian rhinoceros, cave hyena, cave bear, wild horse, ass, deer, etc.; also small primitive tools and traces of hard stone, indicating that the cave was man's dwelling place. In 1924 I found in a neighboring cave, Kiik Koba, in a Quaternary stratum, in two ash and charcoal hearth layers remains of the same animals with a great number of siliceous tools typical of the Middle Palaeolithic period found for the first time in Russia. Of the greatest scientific importance was, however the burial of a man found in a grave within the cave, the remains quite intact showing great differences from the bones of modern man. The study of the bones is still unfinished but suggests that they belong to representatives of a Neanderthaloid race. Hope to find remaining parts of skeleton and skull. Investigation of the material from the cave of Kiik Koba cannot however be brought to an end in Russia where there is no comparative material of Middle Paleolithic man.

Professor Joukoff of the Institution for Anthropological Researches declares that the study of the bones of the skeleton from the Kiik Koba cave gives results approaching those to the Neanderthal type and partly even inclined towards conditions in anthropoid apes. The final word cannot be said until the data can be compared with Western material. The well-known geologist, Professor Pavlov, declares that the chief interest in Professor Bonch-Osmolovski's discovery lies in the fact that it indicates new dwelling places of Neanderthaloid man and Mousterian culture.—*Moscow Telegraph Agency.*

Boskop Remains from the South-east African Coast. By Dart (Raymond A.)—*Nature*, 1923, CXII, No. 2817, 623–625.

In June 1923, Mr. FitzSimons, Director of the Port Elizabeth Museum, who has been for some time excavating the rock shelters in the neighborhood of Potchefstroom, Transvaal, near to where in 1913 the Boskop fossil skull was discovered, "forwarded to the Department of Anatomy in the University of the Witwatersrand a consignment of skeletal material which contained the remains of several members of the ichthyophagous Strandlooper race which preceded the Hottentots along the coastal areas. The Strandloopers, now extinct as a race, were the builders of gigantic kitchen-middens in South Africa." Beneath these remains, however, he found fragmentary parts of about five individuals which "afford definite evidence that they belong to the same race as was found in the Transvaal in 1913."

Unfortunately the remains are very defective. Nevertheless "Through this discovery we now know definitely that the Boskop race preceded the Strandlooper race historically...We know further that the first Boskop specimen was no human freak, but a type representative of a race once widely distributed in South Africa from the Transvaal to the remotest south-eastern corner of the continent."

"The more detailed study of the remains may throw clearer light upon a bizarre mingling of characteristics which at the present time is highly confusing. It may prove justifiable, as Broom is already convinced, to separate this human group from both Neanderthal and Cro-Magnon man as a separate species (*Homo capensis*). There is no doubt meantime, that these new human documents which have been brought to light through the energy and enthusiasm of Mr. FitzSimons, have further emphasized the anthropological wealth of Africa, and the need for more cautious investigation of the deeper strata of our coastal rock shelters, with the strictest observance of the methods of modern archaeology."

Le cerveau des hommes fossiles. By Anthony (R.)—*Bull. & Mém. Soc. d'Anthrop. Par.*, 1923, IV, Ser. VII, fasc. 1, 2, 3, 54–68.

A valuable discussion by one of the best qualified workers in these lines. As to the brains of early man we know little more than those of the Neanderthals. These show that at their period the human brain had already about reached both the volume and the essential characteristics of the human brain of to-day. But it still possessed numerous primitive features. The convolutions were gross and more simple, the frontal lobes smaller, the whole brain decidedly lower. On the other hand the visual and auditory parts were apparently considerably developed.

Further studies in this important line are being carried on by the author.

Eine Rekonstruktion des Urmenschen. By Eickstedt (Egon v.)—*Umschau*, Vienna, 1924, 714–716.

A description of a new painstaking attempt at a reconstruction of the head, face and neck of the Neanderthal man. The result is of considerable interest, though suffering like some notable previous efforts from the absence of beard and, in this case also, an insufficient indication of hair.

Tertiary Man in Argentina.—Nota Sobre Los Supuestos Descubrimientos del Doctor J.G. Wolff, en Patagonia. By Imbelloni (J.)—*Rev. Univ. Buenos Aires*, 1923, LI, 39–51.

"In the last week of February, 1923, there came to Buenos Aires from the distant territories of the south Dr. Joseph G. Wolff who . . . announced on February 28 in the daily paper "La Nación" that he had made extensive voyages and explorations in the territory of Santa Cruz and had discovered documentary proofs of the existence of man in this region in epochs of the remotest antiquity. The finds consisted of: (1) An artificial wall encountered in a valley of the hills which rise between the lakes of Cardiel and Strobel, the wall being 150 meters broad, 12 meters in height and composed of stone blocks 1 meter broad; (2) Ornamental figures and undecipherable inscriptions engraved on one of the surfaces of the wall; while on the other surface there were marks of a monumental arch; (3) Of a cemetery on the meseta Strobel six leagues north of the wall, of stone inscriptions which corresponded to those on the wall; and of (4) A fossilized skull, found previously by an individual in Paso Ibáñez. This specimen remained in Patagonia jealously guarded by its possessor. Nevertheless the explorer having examined the specimen declared the same to be a human skull perfectly petrified and belonging to the Tertiary deposits which are exposed in that locality."

The news of these important discoveries was cabled to North America and to Europe. It naturally aroused also a good deal of local interest which resulted in further inquiries into the matter, and the result of these inquiries was very destructive.

In the first place it was found that the so-called inscriptions were merely samples of the well-known rock engravings of the Indians. The wonderful wall when visited proved to be a natural wall of basaltic lava, the cracks in this "wall" simulating somewhat the joints of stones. The "arch" or portion of an arch was a natural impression. Finally the "skull," on being brought to Buenos Aires and subjected to the examination of a commission composed of Professors Bowman, Dabbene, Lehmann-Nitsche, Outes, and Doctors Vidakovitch and Imbelloni, was found to be just a piece of natural rock, 11 lbs. in weight, showing a few depressions and other features which faintly resembled some parts of a skull. It was a *lusus naturae*.

The report brings excellent and very convincing photographs of both the "wall" and of the concretion. An interesting fact, noted in the report, is that certain scientific men in Europe have already pronounced themselves in favor of the tertiary character of the "skull."

LATER PREHISTORIC MAN

DIE ANTHROPOLOGISCHEN FUNDE AUS DEN PFAHLBAUTEN DER SCHWEIZ. By Schlaginhaufen (Otto)—*Mitt. Antiquar. Gesell.* Zürich. 1924, XXIX, No. 4, 220–240.

A study of 73 skulls from the Swiss pile-dwellings (of which 42 from the Neolithic, 31 from the Bronze phases) leads the author to the following conclusions:

The population of the oldest part of the Neolithic period was distinct from that of later times. It was in the main brachycephalic, with low face and orbits and broader nose. During the middle Neolithic this type is changed through admixture of more northern elements, dolicho-, and sub-dolichocephalic, with medium high to high face, and there follow a tendency towards higher and narrower head as well as face. with facial disharmonies.

By the time the Bronze period is reached the short heads with "pure" broad face has disappeared. The majority of the population present short and especially meocephalic heads in which the facial features vary; but besides these there are long heads, partly with mixed, partly with still harmonious (long and narrow) faces.

DIE MENSCHLICHEN SKELETRESTE AUS DER STEINZEIT DES WAUWILERSEES (LUZERN). By Schlaginhaufen (Otto)—1925, small 4°, Erlenbach-Zurich (Eugen Rentsch), 276 pp., 12 pl., 52 figs. in text.

A handsome volume devoted to a detailed and comparative study of a small series of early Neolithic to possibly Mesolithic skeletal remains from the pile-dwelling sites of the former Wauwilersee, in Switzerland. The material consists of the skeleton of a woman (short, mesocephalic, relatively low and broad face, lower jaw with primitive characters); a robust male femur, with a low angle of the neck (106°); and a few isolated bones or fragments. In the author's opinion both these skeletons and the femur show various peculiarities which point to earlier human forms.

The richness of the volume lies essentially in its comparative part which deals with most of the skeletal remains of antiquity.

The book is exceptionally well printed on good paper and the illustrations—line figures— are all that could be desired.

Die Rassen der jüngeren Steinzeit in Europa. By Scheidt (Walter)—München, 8°, 1924 (J. F. Lehmann), 120 pp., 30 charts, 8 pl. and bibliogr.

Publication of much value giving a compilation of data on a great number (579) of widely scattered skeletal remains from the later or "younger" parts of the Neolithic period.

The skulls included are from Sweden, Finland, Denmark, Germany, Silesia, Moravia, Bohemia, Austria, Hungary, Jugoslavia, Rumania and Switzerland. There are dolichocephals and brachycephals, the former predominating, as well as intermediate forms; and a few regions show but one type alone. For details and the interesting disussion it is necessary to refer to the original.

The volume brings a rich bibliography of the subject and numerous illustrations of the skulls.

Solutrean Man.—*Bull. No. 1, Ass. rég. de Paléont. hum. & de Préhistoire*, Lyon, Feb. 1923, 16 pp., 9 figs. in text.

The report at hand, prepared and issued by the above-named Association, brings considerable information of value on the classical site and finds at Solutré. It gives illustrations of the site, a history of its discovery and excavations, its stratigraphy, and the results, both cultural and skeletal, of the excavations. It also discusses the still remaining uncertainties relating to the type of the Solutrean man. The definite settling of these questions must await further well authenticated discoveries.

Soultré. Archaeology—By Arcelin (F.); Anthropology—By Mayet (L.)—*Bull. No. 2, Ass. rég. de Paléont. hum. & de Préhistoire*, Lyon, June 1924, 3–31.

The authors descirbe new excavations on the site of Solutré in 1922 and 1923. The account is preceded by a history and description of the site. In September, 1923, the explorers recovered three adult human skeletons besides traces of three others of children and a fetus. These skeletons lay beneath the great accumulation of bones of animals, particularly horses, upon which the Solutrean population subsisted and in the opinion of the authors the burial belonged to an older period, namely the upper Aurignacian.

Skeleton No. 1 is that of a woman of rather submedium stature (abt. 155 cm.) and mesocephalic (C. I. 77.7), fair-sized skull.

Skeletons 2 and 3 were those of males of tall stature (No. 2 abt. 183 cm., No. 3 abt. 175 cm.), robust, and with a fair-sized nearly subbrachycephalic skull (C. I. No. 2—79.3, No. 3—79.1).

In general all three skeletons closely approach the modern type of man. The authors are of the opinion that they belong to the Cro-Magnon strain.

The excavations here mentioned were followed by further work in 1924, and the results of this, including several additional skeletons, indicate that the exact age of the previous finds must still be held *sub judice*.

NOTES

New Anthropological Journal. *Journal Kazanskavo Medico-Antropologičeskavo Obščešstva* (J. of the Medico-Anthropological Society of Kazaň).

The Journal, the first large and creditable number of which (280 pp.) bears the date of 1921, is to serve the growing mutual interest of Medicine and Anthropology. A copy has not yet been received in this country, but the Journal is favorably referred to in *Anthropologie* (Prague).

New Anthropological Journal. *Bulletin de la Société d'étude des formes humaines.* I, 1923, II, 1924, Paris, (Librairie Legrand).

This new Journal is to be devoted essentially to the study of the human form from the biological, morphological and artistic points of view. Editor: Léon Mac-Auliffe.

Biologia Generalis. It is the purpose of this note to call attention to a new biological journal, available to American workers, the first number of which will appear shortly. This journal, *Biologia Generalis*, is truly international in character, accepting contributions in either English, French, German, Italian or Russian, according to the author's wish. The responsible editorship rests in the following three persons: Professor Vladislav Ruzicka, Institute of General Biology, Prague, Czecho-Slovakia; Professor Leopold Löhner, Institute of Physiology, Graz, Austria; and the writer of this note. Cooperating with these three are numerous coeditors.

The responsible publisher is Emil Haim and Company (Vienna and Bratislava, C. S. R.), and the American publisher's agent, The Johns Hopkins Press. The journal will appear in numbers of five signatures each, six numbers forming a volume. The numbers will, in general, appear at as frequent intervals as the accumulation of material for publication demands.

Biologia Generalis will be open to original articles dealing with the three main divisions of general biology, namely, general morphology, physiology and ecology, without prejudice to the different methods or direction of research except the purely metaphysical ones. The editorship hopes that all workers interested in general biology and kindred branches of science will make full use of this journal.

Manuscripts and inquiries relating to editorial matters originating in America should be sent to Raymond Pearl, Department of Biometry and Vital Statistics, The Johns Hopkins University, Baltimore, Maryland. American inquiries relating to subscription and other business matters should be addressed to The Johns Hopkins Press, Homewood, Baltimore, Maryland.

The Royal Anthropological Institute has moved from its old home at 50 Great Russell Street to more suitable premises at 52 Upper Bedford Place, London.

THE INDIAN SECTION OF THE ROYAL ANTHROPOLOGICAL INSTITUTE. The Council of the Institute has authorized the institution of an Indian Section for the study of Indian archaeology and ethnology. The aim of the Section will be, in the first instance, to provide facilities for workers interested in Indian studies to meet both informally and at full sessions of the Institute. In addition it will cooperate with workers in India and aim at providing a centre for the co-ordination of the anthropological work which is being carried on in the different parts of that country. In order to carry on with greater prospects of success the Institute has acquired and will henceforth publish the *Indian Antiquary*.

FRANKFURTER GESELLSCHAFT FÜR ANTHROPOLOGIE, ETHNOLOGIE UND URGESCHICHTE. Vortragsfolge für den Winter 1924–25.

A program of proceedings of this Society for 1924–5 shows that under the energetic leadership of Professor Wegner there is developing in this old and rich city in connection with its Museums a remarkably healthy and active center of Anthropology. The program brings the announcement of no less than fourteen major presentations by men invited from many quarters.

A Japan Eugenic Society has been organized under the management of R. Goto. A monthly magazine, of which the English part of the title is "Eugenics" is being published to spread the knowledge of eugenics in Japan. *Science* LX, 154.

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES.—The National Research Council has been entrusted by the Rockefeller Foundation with the expenditure of a sum of $325,000, available between July 1, 1923 and June 30, 1928, to promote research in the biological sciences, including Zoology, Botany, Anthropology, and Psychology, by post-doctorate research fellowships.

Purposes.—The purpose of the National Research Fellowships in the Biological Sciences is the promotion of fundamental research in these subjects. It is believed that this purpose will be most surely advanced by developing a greater number of thoroughly trained investigators. The present policy of the Board of Administration will, therefore, be to restrict appointments to applicants in relatively early stages of a research career, who have demonstrated a high order of ability, in order to enable them to continue research at suitable institutions, preferably in the United States. It is hoped that the establishment of such fellowships may prevent the loss of research interest in the early post-doctorate years by the premature or excessive absorption of promising investigators in routine duties, and may also improve the conditions for research in the educational and other scientific institutions of this country.

The term *educational* or *scientific institutions*, as herein used, is not to be interpreted as referring exclusively to colleges, universities, and technical schools, but may include such institutions as marine or fresh-water stations, museums, government bureaus, or special research institutions.

Stipends.—Fellowship stipends are not intended to compete with the salaries of teaching and industrial positions. They are calculated to provide comfortable living conditions for exceptional research students. They will be adjusted to family responsibilities, individual circumstances and needs. The basic stipend for first appointments will be $1,800. Appointments of fellows are for twelve months and may be made at any time but usually so as to coincide with the beginning of the academic year.

Fellowship Regulations.—Fellows are expected to devote their entire time to research, except that during the college year they may, by written permission of the Board, give a portion of their time, in general not more than one-fifth (outside preparation included), to teaching of educational value to themselves, or to attendance on advanced courses of study. They may associate graduate students with their researches. They shall not engage in work for remuneration during the term of their appointment.

Fellows are expected to submit to the Board shortly before March 1 of each year a detailed report, in duplicate, on the progress of their work. They must also present an account of their research in form as for publication before termination of the fellowship. It is understood that all results of investigation by the Fellows shall be made available to the public without restriction.

The publications by a Fellow of the results of the investigations carried on during the tenure of a fellowship must include a suitable acknowledgment. When such publications appear the author is expected to furnish twelve copies of each paper to the Secretary of the Board of Fellowships in the Biological Sciences, National Research Council, Washington, D.C.

Appointments are subject to the condition that when a fellowship has been accepted by the applicant, it will not be vacated within the year without the consent of the Board.

Applications.—Each application for a Research Fellowship in the Biological Sciences will be considered individually on its merits. Especial attention will be given to the probability of meeting the purposes for which the fellowships were established.

Fellowships will be appointed for one year but they are eligible for reappointment.

Applicants must supply evidence of their research capacity, training, and intentions. This will usually include the following items:

1. A doctor's thesis or its equivalent.
2. Reports of other research work in printed or manuscript form.
3. (*a*) Academic and personal record; (*b*) an outline of the proposed research program, including the institution at which it is planned to work. These items should be presented on blanks which are provided by the Secretary of the Board.

In addition to the foregoing, endorsements of responsible scientists including estimates of the applicant's qualifications will be required. These communications should be sent directly by the writers to the

Secretary of the Board of Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

Cooperation of Institutions.—It is anticipated that institutions at which Fellows are received will waive fees and will extend the usual facilities and services accorded other research workers.

The personnel, equipment, and presumptive cooperation of institutions will be considered in determining the residence of National Research Fellows in the Biological Sciences.

Administration.—The special funds for National Research Fellowships in the Biological Sciences will be administered by a Board appointed by the National Research Council.

The Eugenics Record Office, Cold Spring Harbor, L. I., N. Y., has just issued a new schedule: "Physical Developmental Record for American Males." This is intended primarily for parents who are sufficiently interested to keep a record of their sons, between the ages of 3 and 20 years, and who wish to compare that record with a standard. The schedule provides standards as follows:—development of mean stature, yearly increment of stature, development of mean weight, development of mean absolute sitting height, development of mean relative sitting height, development of mean absolute span of arms, development of mean absolute chest girth, development of relative chest girth. Each "curve" of development is plotted on quadrille ruled paper, graduated along the base into years and twelfths (months) and along the vertical into centimeters (inches), kilograms (pounds) or percentages as the case may require. Detailed descriptions of plates and methods of measuring and general instructions as to use of the charts are printed. The booklet (of 16 pages, 9 x 12″) will be sent free of charge to any parent who will apply for it to the Eugenics Record Office and will agree to make measurements of the boys at frequent and regular intervals and report the findings to the Eugenics Record Office where a duplicate of the record will be kept. Any person may obtain a copy of the Record by writing to the Educational Exhibition Company, 26 Custom House Street, Providence, R. I. which makes a certain charge for it.

C. B. D.

RIVERS MEMORIAL MEDAL. The first award of the Rivers Memorial Medal for anthropological work in the field has been made by the Council of the Royal Anthropological Institute to Dr. A. C. Haddon, F. R. S., for work in New Guinea, Torres Straits and Borneo.

In March Dr. A. Hrdlička is leaving for a prolonged trip to India, the Straits Settlements, Java and Australia, in quest of traces of early man and his fossil predecessors.

A GORILLA SANCTUARY. "In the *Times* (London) of September 5, 1924, Mr. J. G. Whiteley states that the Belgian Government is establishing a large tract of territory comprising an area of 250 square miles of high and healthy territory in the Kivu district of the Congo State, which is especially the gorilla country, for a sanctuary for all kinds of wild animals, including gorillas, and of plants. Provision has been made for a sufficient number of wardens to prevent the intrusion of hunters and the destruction of plants or trees. The area embraces the three volcanoes of Mounts Mikeno, Karissimbe and Vissoke."

Science Progress, 1925, XIX, No. 75, 492.

According to an Associated Press dispatch dated July 11, Russian archaeologists who are excavating near Krasnoyarsk, Siberia, have unearthed several human bodies belonging to the Stone Age, a number of prehistoric mammoths, bisons, gigantic stags and more than 700 stone and bone implements, ornaments and weapons of the prehistoric era. The remains are evidently post glacial, but one of the human skeletons found by the explorers is believed to be at least 17,000 years old. The expedition was undertaken two years ago in an attempt to fix the place of the abode of prehistoric man in Siberia. It was working under the direction of Professors Auerbach and Sosnowsky, Russian archaeologists.

It is a little known fact that in 1913 excavation in the very promising old caves of Birusi on the Yenisei river, above Krasnoyarsk, were conducted at the instigation of Dr. Hrdlička and under the auspices of the Smithsonian Institution, by Professor K. Stolyhwo of Warsaw. The interesting remains that were recovered are in the U. S. National Museum. They were post-paleolithic, though old.

Dr. A. E. Jenks received the degree of Doctor of Science from Kalamazoo College, his *alma mater*, June 18th at the time of delivering the Commencement address on the subject "The Dawning Era of Science."

After finishing his duties as Chairman of the Division of Anthropology and Psychology, National Research Council, Washington, D. C. and Professor of Anthropology, University of Minnesota, Dr. and Mrs. Jenks have left for an extended trip to Europe, for the purpose mainly of visiting the continental anthropological institutions and collections.

✠ Dr. Dudley A. Sargent, the universally acknowledged dean of physical education in America, died on July 21 at the age of 75. Dr. Sargent, in his capacity of Physical Director at Harvard University, a position which he held for many years, developed a highly efficient system of anthropometric examination of the students which, together with the instruments invented for the purpose, is in universal use in American educational institutions. Dr. Sargent also published a series of valuable articles dealing with his anthropometric work on students (see Hrdlička's "Physical Anthropology; Its History and Present Status in the United States," 8°, Wistar Institute, Philadelphia, 1919, 85–'6; also "Who's Who in America." For a symposium of tribute to Dr. Sargent see "American Physical Education Review," October, 1924).

✠ Dr. BURT G. WILDER, emeritus professor of neurology and vertebrate zoology in Cornell University, died on January 21, in his eighty-fourth year. Professor Wilder was for a long time one of the most active members of the American Anatomists; and he will be also gratefully remembered by the Physical Anthropologists of this country for establishing one of the richest collections of human and animal brains that now exists.

✠ JOHN IRVINE HUNTER. We learn with deep regret of the death of the promising young Australian anatomist, Dr. John Irvine Hunter, Professor of Anatomy at the University of Sydney. He died of typhoid at the early age of twenty-seven.

✠ ERNEST CHANTRE. Ernest Chantre, one of the oldest and foremost representatives of French Anthropology, died, in his 82d year, on Nov. 24th last. He expired, active to the last, near Lyon, which since 1871 was the center of his activities. In the latest number of *L'Anthropologie* (1924, No. 6) Professor Verneau gives details about his scientific activities with bibliography.

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THE ASYMMETRICAL CHARACTER OF HUMAN EVOLUTION

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Within the past few years the discoveries of new fossil forms of man and of the anthropoid apes have made it very obvious that the early range of the giant Primates was considerably more extensive than most anthropologists previously were willing to admit. A remarkable and indubitably ancient form of man has come to light in Northern Rhodesia. A precursor of the modern Australian man has been discovered at Talgai, Queensland, and Professor Dubois, the discoverer of Pithecanthropus erectus, has disclosed the fact that his Java finds included apparently Australoid human crania, the knowledge of which he imparts to his fellow-workers only after some two-score years of silence. A molar tooth from the Middle Pliocene deposits of Nebraska has been pronounced by distinguished authorities to be that of a new genus of anthropoid ape, and the face and endocranial cast of a young anthropoid ape, claimed by its discoverer to show humanoid characters, has just been recovered from the limestone at Taungs, Bechuanaland, South Africa. More than this, some of the most recalcitrant antagonists of the eolithic theory have recanted and have admitted the human origin of the Pliocene flints from the 16-foot level of the Foxhall gravel pit in England, thus acknowledging the existence of an implement-using Tertiary man.

It is apparent from these discoveries that early human types had a wider distribution, were present in greater variety, and reached in some instances, essentially human levels of culture, at a far more remote period than most anthropologists and archaeologists have been willing to admit. Students of human evolution seem usually to have interpreted the data of their subject from the viewpoint of an implicit faith in an unilinear and symmetrical evolution, through the cumulative changes of minor variations, adaptations, or whatnot. Postulating the development of humanoid offspring from the common anthropoid-human stock, they have inferred a slow but harmonious progression toward some generalized type of modern man—"Homos sapiens"—from which in recent times the various existing varieties have differentiated by isolation, selection, environmental adaptation, and miscegenation. The discovery of the Neanderthal race seemed to furnish confirmation of this theory in that it represented, apparently, a very primitive human stock with many anthropoid reminiscences more or less harmoniously distributed throughout the skeletal structure. It was only after an intensive study of the various skeletal remains of representatives of this extinct race, that it was recognized that Neanderthal man was, in some respects, a highly specialized and evolved being.

Again the finding of Pithecanthropus erectus in Java seemed to provide in the sub-human character of its calvaria a satisfactory intermediate stage between the Neanderthaloid form and the postulated anthropoid ancestor. But the femur associated with Pithecanthropus was totally non-Neanderthaloid and essentially like that of a modern man. To regard the somewhat gorilloid femur of Neanderthal man as a higher development of the Java femur was obviously impossible. The difficulty was satisfactorily solved for many by the assumption that the ape-like skull-cap and the human thigh bone were fortuitously associated.

Later the discovery of the Heidelberg jaw seemed to provide Neanderthal man with a satisfactory precursor and Pithecanthropus erectus with a possible successor. But the Piltdown skull with its essentially human brain-case and its chimpanzee-like mandible defied all efforts at a rational inclusion of this specimen in any unilinear evolutionary scheme. The obvious way out of the difficulty was again sought by anatomists who declared the mandible to be that of a chimpanzee. The recent find of another frontal fragment together with a molar tooth in all respects similar to those in the mandible of Eoanthropus seems to provide new and convincing evidence that the brain-case and lower jaw of the earlier discovery belong to the same individual. Even if one cuts the Gordian knot by declaring the Piltdown mandible to belong to one ape-like individual and the brain-case to another essentially human individual, the two make strange bed-fellows in a deposit certainly earlier than any in which the remains of Neanderthal man have hitherto been found. The fundamental incompatibility remains.

The object of this paper is to attempt a demonstration of the essentially asymmetrical character of human evolution. It will be shown that all fossil types of man heretofore discovered manifest certain morphological inequalities in the development of various cranial parts, identical in kind, and differing in degree only, from those displayed by the Piltdown specimen. Further it will be demonstrated that similar disharmonic, contradictory, or asymmetrical features are by no means uncommon in modern human races, but are in fact characteristically present. For present purposes the demonstration of such asymmetries is confined to morphological cranial features, because measurements and indices provide in themselves no satisfactory criteria of evolutionary development, and are, in any event, impracticable, because of the imperfect and fragmentary state of most fossil remains. With respect to asymmetries in skeletal parts other than the crania, a few remarks only will have to suffice.

The method of this investigation is as follows: The most important cranial morphological features have been graded under six heads, according to presence or absence, degree of development, and form. Thus we have six morphological grades: (1) Excessively anthropoid, (2) Typically anthropoid, (3) Supra-anthropoid, (4)Sub-human, (5) Typically human, (6) Ultra-human. In some instances a character does not present six observable grades of development and in such cases the arrangement of the successively higher gradations is not necessarily consecutive.

A numerical value ranging from 1 to 6 is given to each character in every specimen studied in accordance with the number of the morphological grade to which it is assigned. The anthropoid apes, the more important types of fossil man, and certain modern races have been assigned rank with respect to each of 41 cranial characters, or as many of such characters as are available for examination. The mean ranking of each race or individual specimen is then calculated from the sum total. The asymmetries of cranial morphological features are appraised by contrasting the mean rating of each specimen with respect to (a) braincase, (b) face and jaws, (c) total cranial rating, and by calculating the standard deviations for each specimen or race in terms of morphological grades. The rank of each specimen or race with respect to others is denoted by the table of mean differences (Table IV).

It may be objected that such a quantitative valuation of qualitative characters is purely arbitrary, but all qualitative estimates are more or less arbitrary, and the reduction to a numerical basis at any rate permits a measure of mathematical accuracy in treatment. The principal disadvantage of this method lies in scope it affords for the exercise of a personal equation. In the first place it is probable that some will take exception to the gradation and valuation of certain morphological

TABLE I.

Character	Ultra-Anthropoid	Typically Anthropoid	Sub-Human Supra-Anthropoid
Frontal Region			
1. Brow Ridges	Huge torus	Large torus	Torus
2. Elevation	Absent	Very small	Small
3. Slope	Absent	Slight upward	Medium upward
4. Postorbital constriction	Great postorbital constriction	Marked postorbital constriction	Medium postorbital constriction
5. Breadth	Excessively small	Very narrow	Narrow
Sagittal Region			
6. Breadth	—	Very narrow	Narrow
7. Crest, elevation	High bony crest	Temporal lines meet, no crest	Temporal lines approximate, large elevation
Temporal Region			
8. Zygomata	Huge	Very large	Large
9. Fossae	Huge	Very large	Large
10. Supramastoid crest or ridge	Huge crest joining occipital crest	Large crest joining occipital crest	—
11. Fullness	—	None, depressed	—
Occipital Region			
12. Shape	Plane, sloping up	Sl. convex, slope up	Biconvex, vertically compressed
13. Crest or Torus	Huge bony crest	Medium crest	—
14. Slope of Foramen	Marked backward	Slight backward	Horizontal
Skull Base			
15. Mastoids	None	Traces	Rudimentary
16. Glenoid fossa	None	Traces	Shallow
17. Postglenoid spine	—	Very large	Large
18. Petrous parts	Elevated	Level with basilar process of occ.	—
Facial Region			
19. Malars, size	Huge, protruding	Large, protruding	—
20. Orbits, proportions, shape	Very high, narrow Round or oval	High, narrow Square	High, medium Nearly square
21. inclination	None	None	Slightly down and out
22. Suborbital fossae	—	None, convexity	—
23. Nasal bones, form	Oblong, lancet	Hour-glass, narrow	Triangular
24. length, breadth,	V. long, v. narrow	Long, top n., base m.	—
25. angle or arch	—	None	Slight angle
26. Nasal profile	—	None	Trace, deeply concave
27. Lower borders of nasal aperture	—	None Prenasal sulcus	Indistinct Prenasal sulcus
28. Nasal spine	None	Traces	Very small
29. Nasion depression	—	None	Slight
Prognathism			
30. Facial	Great	Pronounced	Medium
31. Alveolar	Great	Pronounced	—
Palate			
32. Proportions	Very long, m. br.	Long, narrow	Long, medium
33. Shape	—	Convergent U	Long U
Mandible			
34. Size	Enormous	Very large	Large
35. Chin	—	Absent	Rudimentary
36. Genial tubercles	—	None, fossa	Traces, fossa
37. Mylo-hyoid ridge	—	None	Traces
38. Breadth of ascending ranus	Enormous	Very broad	Broad
Teeth			
39. Canines, projection, diastema	Tusk like Large diastema	Projecting Diastema	— —
40. Molars, proportions of crowns	Very long Broad	Long Medium	— —
41. Relative size of m1 and m2	—	m2 larger	—

Inferior Human	Typically Human	Ultra-Human
Large brow ridges	Medium brow ridges	Small brow ridges
Submedium elevation	Medium elevation	High elevation
Pronounced slope	Medium slope	Little or no slope
Slight postorbital constriction	Very slight postorbital constriction	—
Medium	Broad	Very broad
Medium	Broad	Very broad
Temporal lines well separated, med. elevation	Temporal lines far apart, indistinct	—
Medium	Small	—
Medium	Small	—
Large supramastoid ridge	Medium supramastoid ridge	No supramastoid ridge
Flat	Medium convex	Bulging
Medium convex, low	Protuberant, medium height	Steep, almost vertical, very high
Torus	No torus	Marked inion
Slightly forward	Medium forward	—
Small	Medium	Large
Medium depth	Deep	Very deep
Medium postglenoid	Small postglenoid	No postglenoid
Petrous parts depressed slightly	Medium depression of petrous parts	Pr. depression of petrous parts
Medium, protruding	Small, compressed	—
Medium, medium	Medium height, broad	Low, very broad
Rhombus, square	Rhombus, oblong	Oblong, rhombus
Medium inclination	—	Pronounced inclination
Shallow	Medium	Deep
Truncated pyramid	Fat hour-glass	Flat oblong or square
Medium, top m., base m.	Short top br. base br.	Very short, very broad
Low arch	Medium arch	High arch
Moderately concave	Slightly concave-convex	Straight or convex
Dull	Medium	Sharp
Prenasal fossae	No prenasal fossae	—
Small spine	Medium spine	Large spine
Medium	Deep	Very deep
Slight	None	—
Medium	Slight	None
Medium, broad	Short, broad	Very short, m. or narrow
Broad U	Parabolic	Hyperbolic, elliptical
Medium	Small	—
Negative	Positive	Very prominent
Small, no fossa	Medium, no fossa	Large, no fossa
Slight	Well marked	—
Medium	Narrow	—
Non-projecting	—	—
No diastema	—	—
Medium	Short	Short
Broad	Broad	Medium
2m smaller	—	—

Table II.

Character	Gorilla♂	Gorilla♀	Orang♂	Orang♀	Chimpanzee	Pithecanthropus	Piltdown	Heidelberg	Neanderthal	Broken Hill	Combe Capelle	Talgai	Australian	Eskimo	Negro	Guanche	Alpine	Mongol	Mediterranean	Nordic
Frontal Region																				
1. Brow ridges	1	2	5	5	2	2	5	?	2	1	4	4	4	6	5	5	5	6	6	5
2. Elevation	1	2	4	4	2	3	5	?	3	2	5	4	4	5	5	5	6	5	5	5
3. Slope	1	2	4	4	2	3	5	?	3	2	5	4	4	5	5	5	6	5	5	5
4. Postorbital constriction	1	2	1	2	2	2	5	?	3	3	4	4	4	4	5	5	5	5	5	5
5. Breadth	1	2	2	2	2	3	5	?	5	3	5	4	4	4	4	5	6	5	5	5
Sagittal Region																				
6. Breadth	2	2	2	2	2	4	5	?	5	4	4	4	4	4	4	5	6	6	5	5
7. Crest, elevation	1	2	1	3	3	4	4	?	5	3	4	4	4	4	5	5	6	5	6	6
Temporal Region																				
8. Zygomata	1	2	1	2	3	?	?	?	3	3	4	4	4	3	5	5	5	5	5	5
9. Fossae	1	2	1	2	2	?	4	?	3	3	4	4	4	3	4	4	5	4	5	5
10. Supramastoid crest or ridge	1	2	1	2	2	2	4	?	4	4	4	4	4	4	5	5	6	5	6	6
11. Fullness	2	2	2	2	2	2	4	?	4	4	4	4	4	4	4	5	6	5	5	5
Occipital Region																				
12. Shape	1	2	2	2	2	2	4	?	3	4	5	4	4	4	4	5	6	6	5	5
13. Crest or torus	1	1	1	2	2	?	4	?	4	4	5	4	4	5	5	5	5	4	5	6
14. Slope of Foramen	1	2	1	2	2	2	2	?	2	4	4	4	4	4	4	4	5	4	5	5
Skull base																				
15. Mastoids, size	2	1	2	1	2	?	4	?	3	3	5	4	4	3	4	5	6	5	5	6
16. Glenoid fossa	2	2	1	1	1	?	5	?	3	3	5	?	3	3	5	6	6	3	6	6
17. Postglenoid spine	2	2	2	2	2	?	4	?	4	3	3	?	4	5	4	4	5	6	4	5
18. Petrous parts	2	2	1	1	1	?	?	?	?	2	5	?	2	5	4	5	6	5	6	6
Facial Region																				
19. Malars, size	1	5	1	2	5	?	?	?	5	4	4	4	4	2	4	4	4	4	5	5
20. Orbits, proportions, shape	2	2	1	1	2	?	?	?	3	3	5	3	6	3	5	6	5	5	4	4
21. Inclination	2	2	2	2	3	?	?	?	4	4	4	6	4	3	3	3	4	4	5	5
22. Suborbital fossae	2	2	2	2	2	?	?	?	2	2	5	4	5	4	5	4	5	4	6	6
23. Nasal bones, form	1	1	1	1	2	?	5	?	5	5	2	4	5	3	6	4	4	4	2	2
24. Angle or arch	3	3	2	2	2	?	4	?	4	3	5	4	4	4	4	6	5	4	5	6
25. Nasal profile	3	3	2	2	2	?	4	?	4	4	4	4	4	4	4	5	5	4	6	6
26. Nasal bones, size	2	2	1	1	2	?	4	?	5	4	2	5	5	2	6	4	4	5	2	2
27. Lower borders of nasal aperture	2	2	2	2	2	?	?	?	4	3	4	2	4	4	4	6	5	4	6	6
28. Nasal spine	2	1	2	1	1	?	?	?	4	4	5	2	4	4	4	5	5	4	6	6
29. Nasion depression	2	2	2	2	2	?	?	?	4	3	6	6	6	3	4	5	6	3	5	5
Prognathism																				
30. Facial	1	2	1	2	2	?	?	?	3	3	4	3	4	5	4	5	5	5	5	5
31. Alveolar	1	2	1	1	2	?	?	?	4	5	4	3	4	5	3	5	6	5	5	6
Palate																				
32. Proportions	1	2	1	2	2	?	3	3	4	5	4	3	3	6	4	4	6	5	6	6
33. Shape	1	1	1	1	1	?	4	4	5	6	5	3	4	6	5	5	6	6	5	5
Mandible																				
34. Size	1	2	1	2	2	?	2	2	3	?	3	?	4	4	4	5	5	5	5	5
35. Chin	2	2	2	2	2	?	2	2	3	?	4	?	4	5	4	6	5	5	6	6
36. Genial tubercles	2	2	2	2	2	?	2	3	4	?	6	?	4	4	4	6	6	5	6	6
37. Mylo-hyoid ridge	2	2	2	2	3	?	2	3	3	?	5	?	5	4	4	5	5	4	5	5
38. Breadth of ascending ramus	1	1	1	2	2	?	2	2	3	?	3	?	4	3	4	4	5	4	5	5
Teeth																				
39. Canines, projection, diastema	1	2	1	2	2	?	2	4	4	4	4	2	4	4	4	4	4	4	4	4
40. Molars, proportions of crowns	1	1	2	2	2	?	2	2	4	4	4	4	4	4	4	5	5	5	6	6
41. Relative size of m1 and m2	2	2	2	2	2	?	2	2	2	?	3	?	4	4	4	4	4	4	4	4

features presented in Table I. Then, even if the validity of my scheme of morphological rating is admitted, there is much room for difference of opinion with respect to the determinaton of degree of development of the various features in the individual specimens or races. I would suggest that any anthropologist who finds himself in radical disagreement with the results of this study, revise the present scheme of morphological ratings and then proceed to a similar process of grading each individual fossil specimen and each race for himself. I am willing to predict, on the basis of my own experience with several variants of the present method, that such individual revisions of my morphological ratings and judgments as to degree of development will not seriously affect the positions and rankings of the types and races considered.

Table I is the scheme of morphological rating of cranial features. Several points call for comment. I found considerable difficulty in grading the shape of the occipital bone. I finally came to the conclusion that the ultra-human form is that in which the nuchal plane is relatively small and inclined upward only slightly, and in which the occipital plane rises steep and high. Very protuberant occiputs with extensive nuchal planes seem to be less removed from the anthropoid condition. Very high and narrow orbits of round, oval, or square shape are anthropoid. The ultra-human type is low and broad, oblong or rhomboidal in shape, and with a marked inclination of the horizontal axis. Very long and narrow nasal bones are definitely anthropoid, whereas very short and broad nasal bones are excessively human. On the other hand a pronounced arching of the nasalia is a high human development. A slight nasal profile is discernable among the anthropoid apes only in the gorilla. The complete absence of a nasion depression must be considered a simian feature.

Table II shows the individual ratings of the several types and races for each of the cranial characters considered.

Table III permits us to contrast the rating of brain-case and face in each type and to judge of its variability by means of the standard deviation. The gorillas, male and female, show higher ratings for face than for brain-case because of certain humanoid nasal features and because of the frontal deficiency and supraorbital torus. On account of precisely opposite tendencies in these same regions the orang-utans show higher ratings for the brain case than for the face. The standard deviation for orang-utans is high, because of the man-like frontal region which is the markedly asymmetric feature of these apes.

TABLE III. MEAN RATINGS OF CRANIA.

	Brain Case	Face	Total	Standard Deviation
Gorilla, male	1.33	1.65	1.51	0.59
Orang-utan, male	1.77	1.52	1.68	0.90
Gorilla, female	1.89	2.00	1.95	0.66
Orang-utan, female	2.27	1.74	1.98	0.81
Chimpanzee, male	2.00	2.13	2.07	0.64
Pithecanthropus	2.64	—	2.64	0.77
Heidelberg	—	2.70	2.70	0.83
Broken Hill	3.05	3.86	3.46	1.00
Piltdown	4.31	2.30	3.63	1.17
Neanderthal	3.47	3.74	3.63	0.89
Talgai	4.00	3.65	3.81	0.88
Eskimo	4.16	3.91	4.00	0.96
Australian	3.83	4.30	4.10	0.65
Combe Capelle	4.39	4.13	4.24	0.88
Negro	4.50	4.22	4.34	0.65
Mongol	4.94	4.43	4.71	0.67
Guanche	4.89	4.78	4.83	0.69
Mediterranean	5.22	5.00	5.10	0.93
Nordic	5.33	5.09	5.20	0.96
Alpine	5.61	4.96	5.24	0.69

Pithecanthropus erectus is rated on the brain-case only, for obvious reasons. Similarly the Heidelberg specimen is rated only on the face. The brain-case rating for Pithecanthropus is 2.64 and the facial rating for Heidelberg is 2.70. The standard deviations 0.77 and 0.83 respectively are also nearly the same. The Broken Hill skull has a low subhuman rating for the brain-case (3.05), and a considerably higher rating for the face (3.86). The standard deviation (1.00) is very high on account of the association of a gorilloid frontal region and supraorbital torus with an essentially human palate-form, teeth, etc.

The maximun variability is encountered in the Piltdown specimen with a standard deviation of 1.17 grades. This is in consequence of the inferior human rating of the brain-case (4.31) and the anthropoid rating of the mandible and teeth (2.30). The disharmony of this association is clearly evident and is 17 per cent in excesss of that of any other type. The total mean rating of the Piltdown skull is 3.63, which is, curiously enough, exactly equal to the total mean rating for Neanderthal man, a type which shows a much more symmetrical distribution of characters and a far lower standard deviation (0.89).

The Eskimo shows a remarkable blend of anthropoid and human features in consequence of his extraordinary masticatory development. The nasal skeleton and aperture is often excessively simian and a total absence of suborbital fossae is not uncommon. The mean rating of the Eskimo is 4.00, just a little lower than that of the Australian. In this case only I feel that our 41 morphological cranial features fail to provide a satisfactory mean rating for the type. If one were to take into consideration the cranial capacity of the Eskimo, which is very large, the essential disharmony of the type would be greatly increased, but the mean rating would surpass considerably those of the Australian and of the Negro.

The Negro and the Australian both grade as inferior human types and in each case the variability is the same (0.65). The Negro shows a markedly higher average grade (4.34 as against 4.10). In these two types the standard deviation is at its minimum for man, according to our measure. The position of the Combe-Capelle fossil between the Negro and the Australian is of considerable interest. The variability of this Aurignacian specimen is, however, considerably higher (0.88).

The Mongol and the Guanche are hardly more variable than the Negro, but each surpass the latter both in ratings for brain-case and for face. The remarkably high variabilities of the Mediterranean and Nordic types are due to the anthropoid proportions of the nasal bones more than to any other features. The mean ratings of both types are, however, very high.

The Alpine type shows a slightly higher mean rating than the Nordic, because of more advanced features of the brain-case. Its standard deviation is very low (0.69).

The ranking of the several specimens and types with respect to standard deviations in terms of morphological grades is as follows: Piltdown 1.17, Broken Hill 1.00, Nordic and Eskimo 0.96, Mediterranean 0.93, Orang-utan male 0.90, Neanderthal 0.89, Talgai and Combe-Capelle 0.88, Orang-utan female 0.81, Pithecanthropus erectus 0.77, Alpine and Guanche 0.69, Mongol 0.67, Gorilla female 0.66, Negro and Australian 0.65, Chimpanzee male 0.64, Gorilla male 0.59. If these standard deviations are in any sense valid as criteria of variability, it becomes clear that the morphological stability of a type is no measure of its evolutionary position.

Table IV shows the mean differences between the types and races considered. Pithecanthropus shows smaller mean differences from each of the anthropoid apes than from any of the modern races of man. The same is true of the Heidelberg jaw. Obviously the significance of this table is wholly dependant upon the acceptance or rejection on the part of the reader of the present scheme of classification and the application of it to the types and races considered. In the former case there arises from this table important and interesting results with respect to the degree of resemblance and differences between modern races of man, fossil types of man, and the anthropoid apes. Such results are readily

Table IV. Mean Morphological Differences of Crania.

	Gorilla ♂	Orang-utan ♂	Gorilla ♀	Orang-utan ♀	Chimpanzee	Pithecanthropus	Heidelberg	Broken Hill
Gorilla, male	0	0.17	0.44	0.47	0.56	1.13	1.19	1.95
Orang-utan, male	–0.17	0	0.27	0.30	0.39	0.96	1.02	1.78
Gorilla, female	–0.44	–0.27	0	0.03	0.12	0.69	0.75	1.51
Orang-utan, female	–0.47	–0.30	–0.03	0	0.09	0.66	0.72	1.48
Chimpanzee, male	–0.56	–0.39	–0.12	–0.09	0	0.57	0.63	1.39
Pithecanthropus	–1.13	–0.96	–0.69	–0.66	–0.57	0	0.06	0.82
Heidelberg	–1.19	–1.02	–0.75	–0.72	–0.63	–0.06	0	0.76
Broken Hill	–1.95	–1.78	–1.51	–1.48	–1.39	–0.82	–0.76	0
Piltdown-Neanderthal	–2.12	–1.95	–1.68	–1.65	–1.56	–0.99	–0.93	–0.17
Talgai	–2.30	–2.13	–1.86	–1.83	–1.74	–1.17	–1.11	–0.35
Eskimo	–2.49	–2.32	–2.05	–2.02	–1.93	–1.36	–1.30	–0.54
Australian	–2.59	–2.42	–2.15	–2.12	–2.03	–1.46	–1.40	–0.64
Combe Capelle	–2.73	–2.56	–2.29	–2.26	–2.17	–1.60	–1.54	–0.78
Negro	–2.83	–2.66	–2.39	–2.36	–2.27	–1.70	–1.64	–0.88
Mongol	–3.20	–3.03	–2.76	–2.73	–2.64	–2.07	–2.01	–1.25
Guanche	–3.32	–3.15	–2.88	–2.85	–2.76	–2.19	–2.13	–1.37
Mediterranean	–3.59	–3.42	–3.15	–3.12	–3.03	–2.46	–2.40	–1.64
Nordic	–3.69	–3.52	–3.25	–3.22	–3.13	–2.56	–2.50	–1.74
Alpine	–3.73	–3.56	–3.29	–3.26	–3.17	–2.60	–2.54	–1.78

observable from an inspection of the table and it is hardly necessary to comment upon them here.

It should be noted that the manifestation of evolutionary asymmetries in the various races of man does not imply that all known human types are morphologically on the same level and that an advanced feature in one which corresponds to an anthropoid feature in another is necessarily offset by a reversal of these positions with respect to a second cranial feature. Indeed an inspection of our mean gradations affords little comfort to such as are fond of arguing, for example, that the thick everted lips and excessively curved hair of the Negro, being advanced and highly specialized characters, as compared with thin lips and straight hair, demonstrate the impossibility of distinguishing anthropologically between "higher" and "lower" races and reduce human types to an evolutionary stalemate. The morphological status of any animal should be determined from the sum total of significant characters. This is a frankly experimental paper. It appraises only 41 cranial characters. The results are of course, merely tentative. If the method is accorded any measure of professional approval, the scope of the investigation will be enlarged to include the entire skeleton, the soft parts, and as many mensurable features as seem capable of evolutionary gradation. Such an appraisal of the sum total of all significant bodily characters might be expected to yield really definitive results as to racial position and type.

TABLE IV. (CONTINUED)

Piltdown-Neanderthal	Talgai	Eskimo	Australian	Combe Capelle	Negro	Mongol	Guanche	Mediterranean	Nordic	Alpine
2.12	2.30	2.49	2.59	2.73	2.83	3.20	3.32	3.59	3.69	3.73
1.95	2.13	2.32	2.42	2.56	2.66	3.03	3.15	3.42	3.52	3.56
1.68	1.86	2.05	2.15	2.29	2.39	2.76	2.88	3.15	3.25	3.29
1.65	1.83	2.02	2.12	2.26	2.36	2.73	2.85	3.12	3.22	3.26
1.56	1.74	1.93	2.03	2.17	2.27	2.64	2.76	3.03	3.13	3.17
0.99	1.17	1.36	1.46	1.60	1.70	2.07	2.19	2.46	2.56	2.60
0.93	1.11	1.30	1.40	1.54	1.64	2.01	2.13	2.40	2.50	2.54
0.17	0.35	0.54	0.64	0.78	0.88	1.25	1.37	1.64	1.74	1.78
0	0.18	0.37	0.47	0.61	0.71	1.08	1.20	1.47	1.57	1.61
−0.18	0	0.19	0.29	0.43	0.53	0.90	1.02	1.29	1.39	1.43
−0.37	−0.19	0	0.10	0.24	0.34	0.71	0.83	1.10	1.20	1.24
−0.47	−0.29	−0.10	0	0.14	0.24	0.61	0.73	1.00	1.10	1.14
−0.61	−0.43	−0.24	−0.14	0	0.10	0.47	0.59	0.86	0.96	1.00
−0.71	−0.53	−0.34	−0.24	−0.10	0	0.37	−0.49	0.76	0.86	0.90
−1.08	−0.90	−0.71	−0.61	−0.47	−0.37	0	0.12	0.39	0.49	0.53
−1.20	−1.02	−0.83	−0.73	−0.59	−0.49	−0.12	0	0.27	0.37	0.41
−1.47	−1.29	−1.10	−1.00	−0.86	−0.76	−0.39	−0.27	0	0.10	0.14
−1.57	−1.39	−1.20	−1.10	−0.96	−0.86	−0.49	−0.37	−0.10	0	0.04
−1.61	−1.43	−1.24	−1.14	−1.00	−0.90	−0.53	−0.41	−0.14	−0.04	0

It seems to me that the evidence of asymmetrical evolution in both fossil and modern types of man and in the anthropoid apes, can be interpreted satisfactorily in but one way. We must abandon monogenism. I do not mean by this that we must revert to the idea of independent creation of several distinct types of man, but only that our protohuman ancestors must have shown tendencies toward variation along separate lines of development before the essentially human status was attained. For my own purposes, and perhaps arbitrarily, I consider man to have become man at the time when his giant Primate ancestor definitely took to the ground and assumed an upright posture and biped form of progression. The processes of bodily adaptation whereby the essentially human posture and gait were ultimately acquired must have varied considerably among individual anthropoids and may not always have resulted in identical end products. The gorilla certainly represents an unsatisfactory compromise between arboreal and terrestrial adaptation, an imperfect development toward the erect posture and the biped form of progression. I can see no reason why the gorilla has not attained a perfectly human status in these respects except the inherent incapacity of the gorilloid stock to proceed beyond a certain point, an incapacity probably conditioned by ineradicable tendencies toward variation and specialization in other directions.

We know that not every Primate that has adopted a terrestrial habitat has become man. The ancestors of the baboon assumed a pronograde posture and have converged upon the quadrupeds. Why did they not stand upon their hind legs and become man? I cannot conceive of any environmental factor which could have determined this unfortunate choice. If the gorilla and the baboon have taken to the ground and have adapted themselves in diverse ways with respect to posture and mode of progression, is there any reason for supposing that these and a single ancestor of man have been the only large Primates to descend to the ground and that there have been only these three types of Primate terrestrial adaptation? Nature does not put all of her eggs in one basket and one must conclude that there have been several differentiations of anthropoids in a humanoid direction, resulting not only in varied postures and diverse methods of attaining the erect posture, but also in varied and asymmetrical development of other bodily parts not directly concerned with posture and gait. One such humanoid development may have attained an almost completely erect posture without any consequent reduction of the jaws or any vast increase in the size of the brain. Pithecanthropus erectus may well represent an anthropoid differentiation in which essentially human position and progression were realized, but in which the impulse of the organism toward hypertrophy of the brain and masticatory reduction was lacking. Natural selection would account for the extinction of this and other relatively unsuccessful experiments. On the other hand a type in which the brain grew to essentially human proportions, but in which the face and jaws remained essentially anthropoid might survive for a longer period of time before succumbing in the struggle for existence, or might even undergo a subsequent modification of the jaws, thus realizing the human status in this respect also. When one studies growth in individual children month by month, he notes an alternation and asymmetry in the growth of various parts of the body. One month, for instance, stature increases disproportionately, and weight remains almost stationary. One month the head broadens; another month it lengthens. Growth energy seems to be directed toward different parts of the body in succession or alternation. Nor is there any reason for believing that these growth sequences are invariably the same for all individuals or that the ultimate development of the several organs is identical.

Similarly one may conceive that the process of human evolution must have varied considerably in the individuals and groups which ultimately attained an erect or nearly erect posture, and such asymmetry would presumably be most pronounced in those parts of the body in which adaptation to the new posture was least necessary. The modification of the foot from a mainly prehensile to a primarily supporting organ was a fundamental requisite for the radical change in its function. This modification has been realized almost completely in every modern race and every fossil type available for study. On the other hand, most of the bodily characters which we regard as criteria of race are not fundamentally concerned in the modifications necessitated by the assumption of the erect posture. It seems to me that many, and even most of them, must be classified as non-adaptive variations. I am not acquainted with any peculiar use of the jaws or teeth in Negroes or Australians which can be considered the functional basis of their prognathism. It appears to be an ancestral feature which has been retained simply through the inertia of heredity. Nor is it apparent that a moderate alveolar projection is a less favorable variation than a condition of hyper-orthognathism. I cannot see how the possession of a brachycephalic head-form, on the one hand, or a dolichocephalic, on the other, can be of any advantage or disadvantage in the struggle for existence. It is not demonstrable that curly hair as contrasted with straight hair, or short hair as contrasted with long hair, are anything else than indifferent variations. And even if one admits that a certain accumulation of pigmentation in the lower strata of the epidermis may be useful in cutting off the actinic rays of the sun, it can hardly be argued that an amount of melanin sufficient to impart a yellow-brown color to the skin is less efficient for that purpose than the excessive pigmentation which renders the skin black. Anthropologists have made ingenious efforts to show that the elevation of the nasal bridge and the narrowing of the nasal aperture in certain races is an adaptation for the breathing of cold air, roughly analogous to our American habit of placing radiators behind a window and opening the sashes slightly so that fresh air may enter the room after being warmed by passing over and through the radiating surface. I am much more inclined to regard the long and narrow nose as a retention of the anthropoid condition, nor is it apparent that the elevation of the nasal bridge can be ascribed to any such adaptation, in the absence of such elevation among the Eskimo. The nasal cartilages, which by their size and shape impart to the tip of the nose characteristic forms which are racially distinct seem to vary independently and in a non-adaptative manner. Equally non-adaptative are thickness or thinness of lips, relatively long or relatively short fore-arms, shovel-shaped or plane-backed incisors, the presence or absence of epicanthic folds, sacral pigmented spots, pharyngeal fossae, and other features often or occasionally recognized as racially variable. It seems very probable that the extremes of racial variability in these features are mainly explicable by the indifferent or unimportant character of such variations, which consequently are determined by the inherent tendencies of the several human stocks, independent of adaptations due to environment. Nature evidently likes to proceed to extremes in non-essentials. And, indeed, certain of the changes in bodily form which have been ascribed with some probability to environmental causes, appear to be of a totally non-adaptive character, e.g. change in the head-form of children born in America of immigrant parentage.

All this tedious discussion grows from my conviction that most racial differences and most evolutionary asymmetries are to be ascribed to the fact that several distinct stocks whose common ancestry must be sought in a proto-human or very inferior human stage of development have developed along lines roughly parallel, but with many unimportant divergences. Not all of these stocks attained to precisely the same status of evolutionary development as measured by the degree of their departure from characteristically anthropoid forms. Some of these became extinct without having realized essentially human levels of development; others have survived at varying stages of morphological evolution, the asymmetry of their development being manifested far more in the mosaic of primitive and highly evolved characters within the same type than by the average development of the sum total of their bodily characters.

Let me not be understood to think that in the Tertiary epoch the tropical forests rained anthropoids, many of which evolved into men, resulting in the dozen or more present human groups which we crudely classify as races. Most of these extant races of man are due to mixtures of the ingredients of two or three primary types. Such miscegenation may well have occurred whenever propinquity permitted, even in proto-human times. Although the present anthropoid apes are not positively known to have produced interspecific hybrids, the existence of hybrids between the gorilla and the chimpanzee has been reported several times and is not wholly incredible. Moreover there seems to be no good reason for doubting that the ancestors of man have displayed throughout the process of becoming human, superior adaptability, greater initiative, and less conservatism in their mating habits as well as in other directions, when compared with the existing anthropoid apes or the progenitors of the latter. An occasional hybridization, followed by a process of inbreeding would satisfactorily account for the varying characteristics of modern races, if the existence of two or three fundamental humanoid stocks is admitted.

Although the *ex oriente lux* hypothesis has generally held sway among anthropologists and students of anthropoid origins, and while many still insist upon the selection of Asia as the continent within which the anthropoid-humanoid Garden of Eden was located, the claims of Africa can no longer be denied. Aside from the convincing evidence afforded by recent fossils finds in Africa, it seems to me that seeking for the origin of the chimpanzee and the gorilla outside of the tropical area which limits their present range and which satisfactorily fulfills every condition for higher Primate evolution, is an essentially irrational method of proceedure.

It seems unnecessary to recapitulate here the evidence that points to an African origin of certain forms of man and of the anthropoid apes, since recent finds have already popularized the recollection of Darwin's opinion and has resulted in a number of adequate restatements of the case. It may be noted however, that up to the present time all finds of fossil man, with the exception of Pithecanthropus and the Talgai specimen, have occurred in areas which are, in a broad sense, marginal to the African tropical region. This applies both to the South African and to the European finds.

Nevertheless it must be admitted that Southern Asia and Southeastern Asia fulfill the climatic and palaeontological conditions necessary for the production of man and the giant Primates in an equally satisfactory manner. Further the occurrence of many anthropoid forms in the fossil deposits of the Siwalik Hills in Northern India and the discovery of Pithecanthropus erectus in Java and of the Talgai man in Queensland (not to mention the distribution of the gibbon and the orang-utan), render the inherent probability of man's originating in this continent very great. It is quite possible that the critical steps in human evolution—the descent to the ground and the assumption of the erect posture—may have taken place in both continents. If one supposes that the anthropoid-human branch differentiated from the main Primate trunk in one or the other continent exclusively, it is nevertheless certain that the arboreal ancestor of man was quite as capable of migrating from Africa to Asia or from Asia to Africa as were the ancestors of the existing anthropoid apes. At present I am inclined to think that one or more long-headed varieties of man evolved in Africa and one or more round-headed varieties in Asia. If one recalls that all of the immediate precursors of the Hominidae were more closely related to each other than to any of the then contemporaneous ancestors of the present anthropoid apes, it is unnecessary to worry over the fact that all Africanoid varieties of man resemble all Asiatic varieties more closely than they resemble the present chimpanzee or gorilla. Certainly in many unessential features the Australians, Negroes, and Neanderthaloids resemble the African anthropoids, whereas in others the Mongoloids seem to display a convergence toward the orang-utan. I do not, of course refer to any of the bodily parts which have been actively concerned in the adaptations involved in the assumption of the erect posture and biped gait, but rather to such variations in form and development as may be observed in the malar bones, the supraorbital ridges, the frontal bone, the depth of the suborbital fossea, etc. The attempt to demonstrate such resemblances or convergences between various types of man and various types of apes lies outside the scope of this paper and is not essential to the present argument. Even if such resemblances are granted and recognized they can scarcely be interpreted as evidence of close relationship between the respective phyla in which they obtain. They may imply rather a protracted period of evolution of separate stocks within the same environmental area, whereby certain features derived from a remote common ancestry have been preserved or similarly modified nonadaptively. It is perfectly conceivable to me that an identical environment may tend to foster similar ancestral features in separate stocks of a common origin.

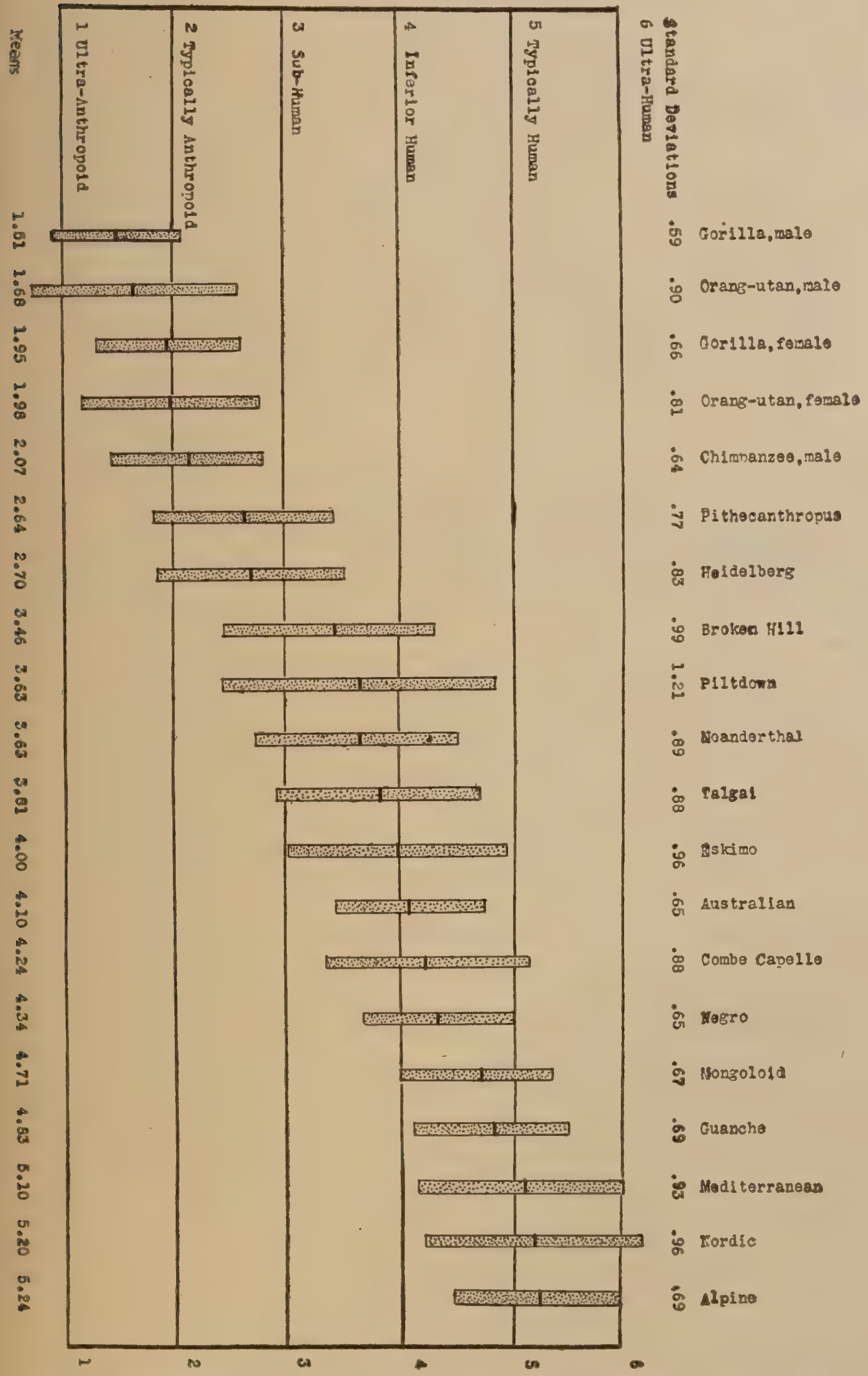

FIG. 1. Mean Ratings of Crania. (Means represented by centers of stippled rectangles, twice standard deviations by lengths.)

CRANIOMETRIC STUDIES

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NO. 1. THE CORRELATION BETWEEN THE NASION-BASION LENGTH AND THE MAXIMUM GLABELLA-OCCIPITAL LENGTH

The series of craniometric studies of which this is the first has only been rendered possible through the courtesy and kindness of my friend, Professor T. Wingate Todd, who granted me permission to examine the unique collection of human crania in the Hamann Museum, Western Reserve University. In addition to free access to the required material I had also the ever present help and cooperation of Professor Todd and his staff, particularly in connection with the working out of the very numerous and, in many instances, complicated mathematical formulae involved in the calculations. It was a real pleasure to be able to work under such advantageous conditions, and I wish to place on record my keen sense of appreciation of many kindnesses.

The crania examined were those of adults, representing all ages from 26 to 85. In the present research the collection has been examined in groups for each sex and each race, but it is hoped in later researches to organize these into decades in order to ascertain the existence of age changes, if any.

It is important to mention that no skull was examined until it had become perfectly dry. Professor Todd fixes for each skull a definite date, previous to which the drying of the bone cannot be said to be complete. In this way any risk of subsequent shrinkage is eliminated as much as possible.

I may state that the Hamann collection of human osteological material is unique, the name, sex, age, and, in most cases, the race of every skeleton in the collection being known and kept carefully recorded. There is indeed nothing else like it in the world to-day. The number of complete skeletons was over 1200 when I was there (May, June, 1924) and the collection is expanding with great rapidity every year.

For my particular research the only crania applicable were those that had been sectioned in the sagittal plane. I found 602 thus treated, and was able to examine these in the most advantageous way.

The object of the present craniometric study was to ascertain from this wealth of material whether or not there was any correlation between the nasion-basion length and the maximum glabella-occipital length. The writer can find no record of this having been done previously.

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The crania were divided into four groups—male White, male Negro, female White and female Negro. Three crania had afterwards to be excluded from the list owing to defect or previous damage, and the final numbers reported upon consisted of 358 male White, 153 male Negro, 51 female White and 37 female Negro—599 crania in all. The extensive series of male white crania represented nationalities from every country or district in Europe, and this was vividly exemplified in the amazingly diverse types met with in this group.

It may be stated at the very outset that a very definite correlation was found to exist between the above two cranial lengths.

The nasion-basion length varied from a maximum of 107 mm. to a minimum of 87 mm. in the female Negroes, from 109.5 mm. to 91 mm. in the male Negroes, from 105 mm. to 85.5 mm. in the female Whites, and from 110.5 mm. to 87 mm. in the male Whites. It will be noted from this list that the degree of racial variation was practically the same in the females of both races—only 0.5 mm. of a difference; but the variation was much greater in the male Whites than in the male Negroes.

The glabella-occipital length varied from a maximum of 192.5 mm. to a minimum of 169 mm. in the female Negroes, from 206.5 mm. to 168 mm. in the male Negroes, from 193 mm. to 161.5 mm. in the female Whites, and from the extreme limits of 210 mm. to 160.5 mm. in the male Whites. It will be observed that the variation was, as in the case of the nasion-basion length, by far the greatest in the male White crania, an amazing divergence of 49.5 mm. It seems incredible that this cranial length should exhibit such an excessive range of variation.

FEMALE NEGROES

A. Basion-nasion length:

The mean was found to be 95.9 mm. and the error of the mean was calculated to be ±0.479 mm. The standard deviation was 4.32 mm., the error of which was found to be ±0.339 mm. The coefficient of variation proved to be 4.5% and the error of this was ±0.353%.

B. Maximum Glabella-occipital length:

The mean was 180 mm.; the error of the mean, by applying the usual formula, being ±0.615 mm. The standard deviation, 5.55 mm., was expected to be slightly higher than in the case of the nasion-basion measurement, owing to the greater cranial length involved. The error of standard deviation was 0.435 mm., the coefficient of variation 3.08%, and its error 0.241%.

MALE NEGROES

A. The nasion-basion length:

The mean of this was 100.5 mm. The error of the mean proved to be ±0.233 mm. The standard deviation, 4.27 mm., was very nearly the same as that of the female Negroes, and the same statement applied to the coefficient of variation, 4.25%. The error of the standard deviation was ±0.165 mm. and that of the coefficient of variation ±0.164%. The closeness of these figures is quite remarkable.

B. The Maximum Glabella-occipital length:

The mean was 186 mm., and its error ±0.327 mm. The standard deation, 5.99 mm., and the coefficient of variation, 3.22%, were both closely similar to the corresponding results in the female Negro crania. The error of the standard deviation was calculated to be ±0.231 mm. and that of the coefficient of variation ±0.124%.

FEMALE WHITES

A. The nasion-basion length:

The mean was 94.8 mm., and its error ±0.425 mm. The standard deviation, 4.51 mm., was slightly higher than in both the female and the male Negroes, while the coefficient of variation, 4.75%, was likewise more unfavourable than in both the female and the male Negroes. The error of the standard deviation was ascertained to be ±0.301 mm., and that of the coefficient of variation ±0.318%.

B. The Maximum Glabella-occipital length:

The mean was 174 mm. and its error ± 0.711 mm. The standard deviation, 7.54 mm., was decidedly more unfavourable than in both the male and female Negro crania, while the coefficient of variation, 4.32%, followed this result consistently, and proved to be worse than in both the male and female Negro material. The error of the standard deviation proved to be ±0.502 nm. and that of the coefficient of variation ±0.288%.

MALE WHITES

A. The nasion-basion length:

The mean was 100 mm. and its error ±0.156 mm. The standard deviation, 4.39 mm., was greater then in both the male and female Negro crania, while the coefficient of variation, 4.39%, was more unfavourable than in the case of the male Negroes. The error of the standard deviation was ±0.1103 mm., and that of the coefficient of variation ±0.1103%.

B. The maximum glabella-occipital length:

The mean was 182 mm. and its error ±0.283 mm. The standard deviation, 7.98 mm., was nearly the same as in the female White crania, and was much more unfavourable than in both the male and female Negro material. The coefficient of variation, 4.38%, was almost the same as that of the female Whites and much worse than in both the male and female Negro crania. The error of the standard deviation was found to be ±0.2006 mm. and that of the coefficient of variation ±0.1101%.

The outstanding fact elicited by these results is, that the American Negro crania, both male and female, are more stable than the male and female White crania, as regards both the standard deviation and the coefficient of variation. This would suggest that the American Negro is racially more homogeneous than the American White. One can well imagine the amazing diversity of White represented by a great middle west city like Cleveland, which is undoubtedly one of the great racial melting pots of the United States. I am interested to find that these conclusions are confirmatory of those obtained by Professor Wingate Todd[1] as the result of a comparison of various cranial measurements in the same material that I have utilized. He was likewise much impressed by the stability of the Negro material, when compared with the relative variability of the results yielded by the crania of the White races. For example he states[2] that—"Comparing the male series, there is somewhat less variability in our Negroes than in our Whites except in the case of auricular height. Probably this greater variability of the Whites is related to the markedly heterogeneous character of the White population." Again in the next paragraph he states—"The absence of any correlation between length and breadth in our male White crania together with the approximately similar correlation of these two dimensions with capacity still further indicate mixed character. Contrast this situation with the condition in the male Negroes. In the latter there is much greater correlation of both length and breadth with capacity and there is fair correlation between length and breadth themselves."

CORRELATION BETWEEN NASION-BASION LENGTH AND THE MAXIMUM GLABELLA-OCCIPITAL LENGTH

It will be useful to mention here how this correlation is calculated. For each skull the deviation from the mean of the nasion-basion length is multiplied by the deviation from the mean of the glabella-occipital length. If both deviations be + or — the result will of course be +, but if one deviation be + and the other—, the result will be—. The + and — columns are added up separately and the totals subtracted. The + column should of course yield by far the larger total in order to obtain a favourable correlation. The result of this subtraction is then divided by a denominator obtained by multiplying together the number of crania, the standard deviation of the nasion-basion length and the standard deviation of the glabella-occipital length. Perfection of positive correlation is represented by + 1, so that one ought to get a result as near this figure as possible in order to prove definitely if there is really any correlation. A minus result of course means that there is inverse correlation. The most pronounced correlation was found in the female White crania where the result was + 0.65. The next best result, +0.4747, was obtained in the male Negroes. The figure for the male White crania was +0.446 and for the female Negroes +0.3563. The errors of the coefficients of correlation were ±0.054, ±0.042, ±0.028 and ±0.096 respectively.

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[1] Cranial Capacity and linear dimensions in White and Negro. *Am. J. Phys. Anthrop.*, 1923, VI. No. 2.

[2] *Op. cit.*, 165.

I cannot close this communication without expressing my gratitude to Professor Wingate Todd, Miss Lindala, Miss Kuenzel and Miss Trenkel of the Department of Anatomy, Western Reserve University, and my colleague, Professor J. H. L. Johnstone, for indispensable assistance in checking many thousands of calculations.

TABLE I. THE NASION-BASION LENGTH.

	Mean	Standard Deviation	Coefficient of Variation
Female Negroes........	95.9±0.479	4.32±0.339	4.5 ±0.353
Male Negroes..........	100.5±0.233	4.27±0.165	4.25±0.164
Female Whites.........	94.8±0.425	4.51±0.301	4.75±0.318
Male Whites...........	100. ±0.156	4.39±0.1103	4.39±0.1103

Note the close approximation of the mean in the females and males of both races. The standard deviation and the coefficient of variation will both be observed to be consistently higher in the White races.

TABLE II. THE MAXIMUM GLABELLA-OCCIPITAL LENGTH.

	Mean	Standard Deviation	Coefficient of Variation
Female Negroes........	180±0.615	5.55±0.435	3.08±0.241
Male Negroes..........	186±0.327	5.99±0.231	3.22±0.124
Female Whites.........	174±0.711	7.54±0.502	4.32±0.288
Male Whites...........	182±0.283	7.98±0.2006	4.39±0.1103

Note that the standard deviation and the coefficient of variation consistently follow the results obtained for the nasion-basion length—being decidedly higher in the White crania both male and female. The close correspondence of the Standard Deviation and the Coefficient of Variation in the White and in the Negro sexual groups is remarkable.

SUTURE CLOSURE—ITS PROGRESS AND AGE RELATIONSHIP

PART IV.—ECTOCRANIAL CLOSURE IN ADULT MALES OF NEGRO STOCK

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INTRODUCTION

In former papers we have dealt with the problem of suture closure on both sides of the male White cranium (1, 2) and on the endocranial surface of the male Negro cranium (3). We have shown that the current conception of a closure tendency should be replaced by a definite modal age relationship in suture union. But we have also made it clear that there is a vast difference between a modal age relationship and individual uniformity. Although we have not yet had the opportunity of presenting our comparative data we have outlined the theory that the human cranium is distinctly aberrant from the mammalian type in its suture closure plan and that this aberration further resolves itself into great individual variation, despite which, nevertheless, a distinct human closure pattern may be discerned. In our discussion we have touched upon some of the influences bearing upon this individual variation. The modal closure pattern of a significant sample of a population is one thing and individual variability obscuring this pattern is quite another. It must be assumed then that the reader has already mastered the main features of the closure pattern before he attempts to understand the precise significance of the facts to be presented in this article.

Of our male Negro crania 79 remain after discarding 41 irregular examples out of the 120 skulls of the sample. These 79 skulls were used in

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the endocranial study and they are again used in the present work. Further additions which have accrued since the investigation started four years ago are not included although they bear out the conclusions presented. It is essential that exactly the same crania be utilized for ectocranial study as for endocranial examination so that the graphs of the two surfaces may be directly comparable. We divide cranial sutures into three categories: sutures of the vault, circum-meatal sutures, and accessory sutures. The reasons for this subdivision we have already presented (1). It remains therefore simply to present and discuss the facts relating to ectocranial closure in the male Negro.

By the term Negro we mean the American Negro. Originally the term Negro-hybrid was employed. This expression however may be and usually is taken to imply a greater admixture of White blood than the facts justify. Whatever the hybridization may have been in the distant past, unpublished studies made in this laboratory indicate that hybridization with Whites has occurred to a much less degree in recent generations than popular opinion takes for granted. This view has also been expressed by Herskovits in a very important recent paper (4). In the work on the endocranial sutures we have discussed the relation of the American Negro graph to that of the male White and we have shown that essentially they follow the same pattern but that variability is more characteristic of the Negro. It is this greater variability together with misinterpreted data upon delayed union (3. pp. 56, 6a) which has resulted in the apparently significant differences insisted upon by earlier authors who have based their conclusions upon entirely inadequate information.

SUTURES OF THE VAULT

1. The Sagittal Suture

(Fig. 1).

There is a single fundamental pattern for both endocranial and ectocranial aspects of the suture but, as in male Whites, ectocranial closure does not attain the degree of completion observed upon the endocranial surface.

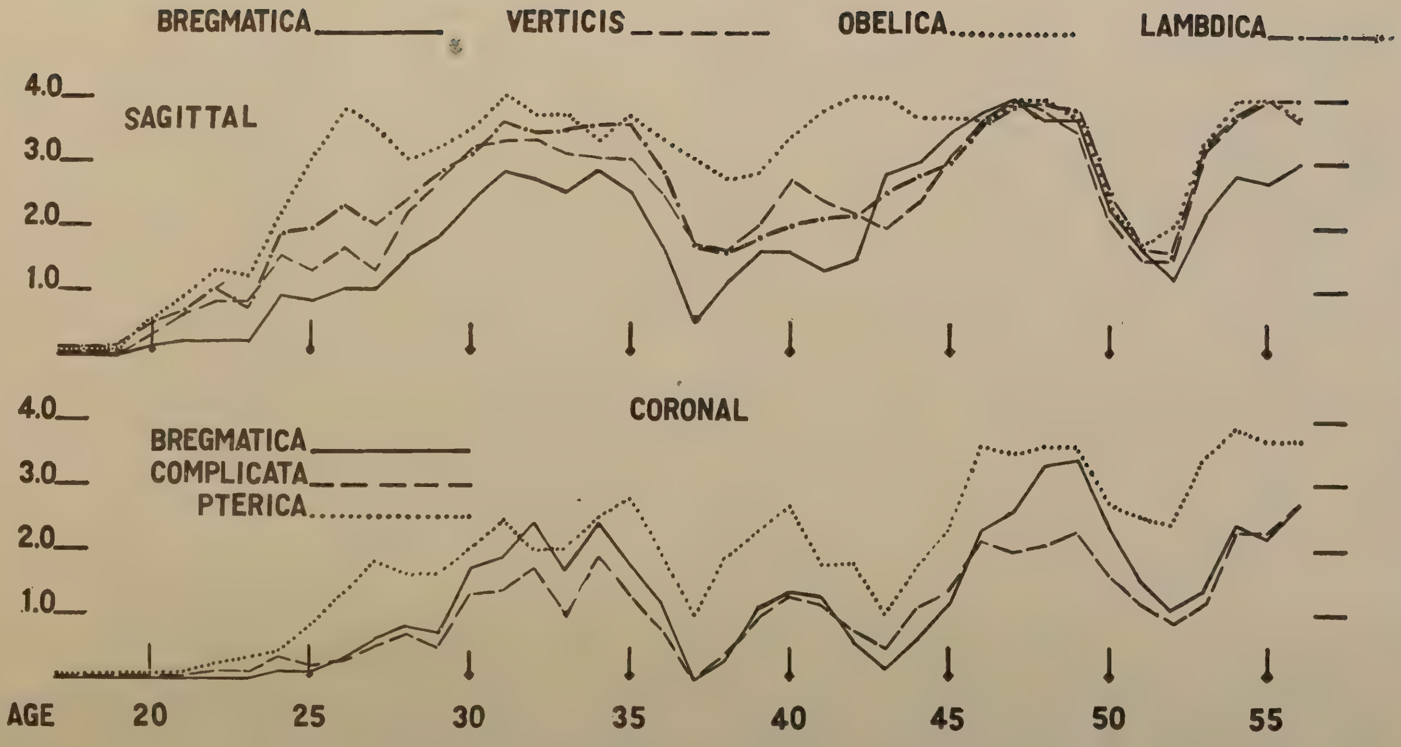
Union is first begun on the ectocranial aspect at twenty years, two years earlier than on the inner face. It continues rather slowly in the main until about twenty-four and then takes on a more rapid character and reaches a stage in the early thirties beyond which it never really progresses. The graph swings about quite considerably after this date, oscillation resulting manifestly from the relative paucity of material and from the individual variability which has already been discussed. Nature, it seems, demands a certain degree of conformity to pattern but, beyond this essential minimum, is not constrained to press uniformity. The degree of conformity is much less upon the outer than upon the inner surface of the cranium. This fact, taken in conjunction with our findings in the male White cranium, permits the important deduction that suture closure obtains its impetus from influences at work upon the inner face rather than from factors bearing upon the outer face. Perhaps the current and erroneous assertion that closure tends to be earlier and more rapid upon the endocranial aspect derives its origin in a hazy conception of the fact which we now emphasize.

Analysing the several parts of the suture as shown in the graph, one finds that the partes bregmatica and verticis hang more or less together, that the lambdica pursues a somewhat different course, and that the obelica is a law to itself.

The obelica commences to close at twenty years. This is two years earlier than on the endocranial surface but is precisely the same age as that for commencing closure on the ectocranial aspect of the male White. Thereafter its graph shows a rapid rise, reaching 3.8 at twenty-six and 4.0 at thirty-two years. These are the significant points; the oscillation after the early thirties is the expression of individual variability as already outlined. Now on the endocranial surface completion is attained at thirty-one and on the outer face in the male White at twenty-nine.

The lambdica also commences to close at twenty years and exhibits a steady continuous progress until thirty-two when union has reached the stage of 3.6. The age delimitation is therefore practically the same as for the endocranial aspect on which however union goes on to completion: it is not widely different from that in male Whites but the degree of closure is greater than upon the ectocranial face of the White skull.

Union in the verticis again appears first at twenty years. It progresses slowly to twenty-three when it has reached only 0.7. At twenty-four the graph stands at 1.5 and progress is rapid up to thirty-two when 3.3 is reached. Beyond this point no further real closure is attained. The slow progress as far as twenty-three is unrepresented on the endocranial face where union first appears at twenty-four but continues rapidly thereafter till complete closure is reached at thirty-one. On the ectocranial surface of the male White closure begins at twenty-one, continues slowly till twenty-five and rapidly from this age till the maximum of 2.7 is reached at twenty-nine.



MALE NEGRO ECTOCRANIAL

FIG. 1a. Ectocranial closure progress in the sutures of the vault. The years between twenty-six and thirty form the period of election for suture closure. The pars obelica of the sagittal has a pattern of its own. Coronal progress slightly precedes lambdoid. The coronal pattern differs somewhat from the endocranial pattern (Fig. 4).

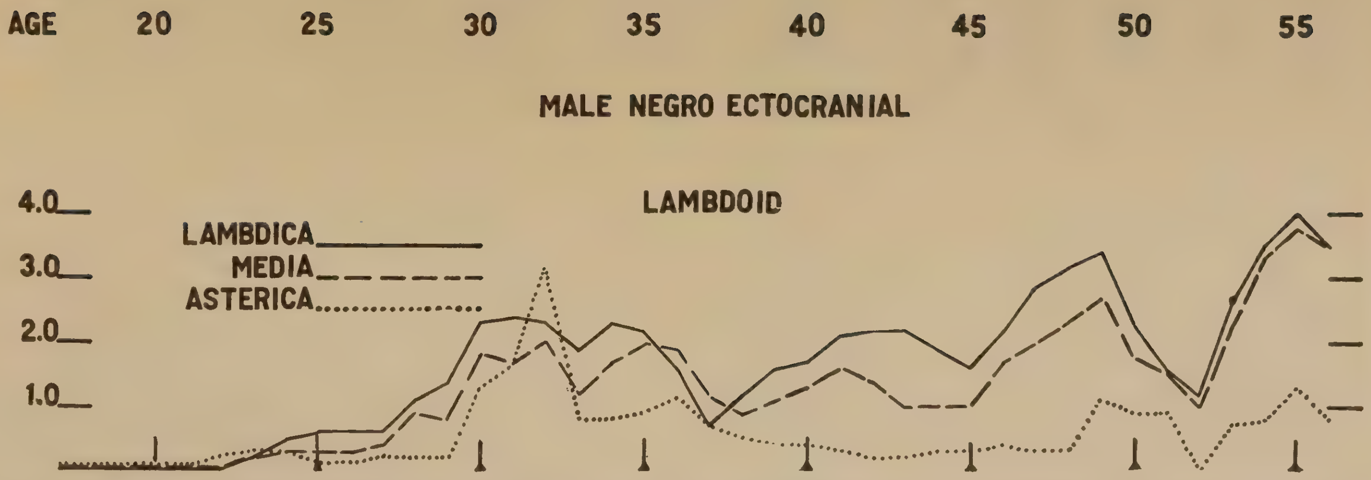


FIG. 1b. Ectocranial closure progress in the sutures of the vault. The years between twenty-six and thirty form the period of election for suture closure. The pars obelica of the sagittal has a pattern of its own Coronal progress slightly precedes lambdoid. The coronal pattern differs somewhat from the endocranial pattern (Fig. 4).

In the bregmatica as in the other parts union first occurs at twenty years. As in the verticis it is slow until twenty-three when the graph stands at 0.4. From twenty-four on to thirty-two closure continues more rapidly and reaches a maximum of 2.9 at the latter age. Here, as in the verticis, ectocranial closure commences earlier than endocranial union and reaches its phase of more rapid progress at a somewhat younger age. But whereas endocranial union is completed at thirty-one, ectocranial closure is never really complete, in spite of the fact that individual crania may exhibit absolute disappearance of the suture. In the male White skull ectocranial union of the bregmatica does not commence until twenty-six but the same maximum of 2.9 is attained already at twenty-nine.

Summing up all these observations we conclude that in the male Negro sagittal suture, closure commences earlier than on the endocranial aspect but that the maximum is attained about the same date in the early thirties. Closure is not so complete as on the endocranial surface. Comparing the ectocranial surfaces of White and Negro we find that union begins about the same age but that the maximum is lower for the White than for the Negro and is attained about three years earlier. Progress then is obviously about the same but is inhibited (or possibly prohibited) at an earlier stage in the White.

2. The Coronal Suture

(Fig. 1)

Endocranially we find that the coronal suture naturally divides itself into two parts, the pars pterica standing alone and the other two parts being associated together. No such distinction is to be found on the ectocranial aspect. In this respect ectocranial closure is strictly in accordance with the closure pattern discovered in the White. It has been held, largely upon the basis of closure in this suture, that complexity in appearance of a suture has a definite relation to age and speed of union. We have been unable to discern any difference in age or rate of closure dependant upon character of suture.

The bregmatica begins to unite at twenty-four, the complicata at twenty-two. In both union progresses with increasing speed until thirty-two when the former stands at 2.4 and the latter at 1.7. Thus both commencement and cessation of union on the ectocranial surface are somewhat in advance of corresponding stages on the endocranial face. It is true however that endocranial union progresses very little and quite slowly after thirty-two. In the White skull union starts in both parts at twenty-six and the graph becomes oscillatory after twenty-nine, at which age the bregmatica stands at 2.3 and the complicata at 0.9. Union, therefore reaches about the same degree in the bregmatica of Whites and Negroes but the complicata progresses a little further in Negroes.

The pars pterica comences to unite at twenty-one and proceeds quite slowly until twenty-four when it reaches 0.4. Then the characteristic acceleration sets in and closure has reached 1.8 by twenty-seven. Slackening somewhat in pace it continues to 2.8 at thirty-five and becomes erratic thereafter. Commencement of union is distinctly earlier upon the ectocranial face and cessation is much earlier than on the endocranial aspect. Compared with the outer surface of the White however the start takes place about the same date and eventually union does not progress so far. There is then no very significant conclusion to be drawn from the fluctuant character of union in the coronal suture.

3. The Lambdoid Suture

(Fig. 1)

In the lambdoid suture there is again no distinction between the pars asterica on the one hand and the upper portion of the suture on the other. There is a distinct tendency in Negro skulls for this suture to exhibit lapsed union but these individuals have all been culled out together as aberrant. In the remaining series union commences in the lambdica and media at twenty-three and in the asterica at twenty-two. Progress is slow till twenty-seven in the lambdica and media. At this age it has reached 0.6 in the former and 0.4 in the latter. Closure is then more rapid and in the lambdica has attained 2.4 by thirty-one, in the media 2.0 by thirty-two years. In the asterica union is slow till twenty-nine when it has reached only 0.2. There is a spurious rise on the graph to 3.1 at thirty-two but closure never really gets beyond 1.0. Actually then the rise of the curve in the early twenties is sporadic and may be discounted: the real progress is in the later twenties and early thirties. Closure then is quite comparable in its development on both faces of the cranium but on the ectocranial aspect it is inhibited after thirty-two years.

If the ectocranial figures for the White skull be consulted it will be found that they are practically identical with those just set forth for the Negro. We find ourselves unable to confirm the assertion made by earlier workers to the effect that modal union in the lambdoid suture is really later in the Negro than in the White. We believe that such differences as may be perceived in an uncritical survey of samples of the two Stocks result entirely from individual variability.

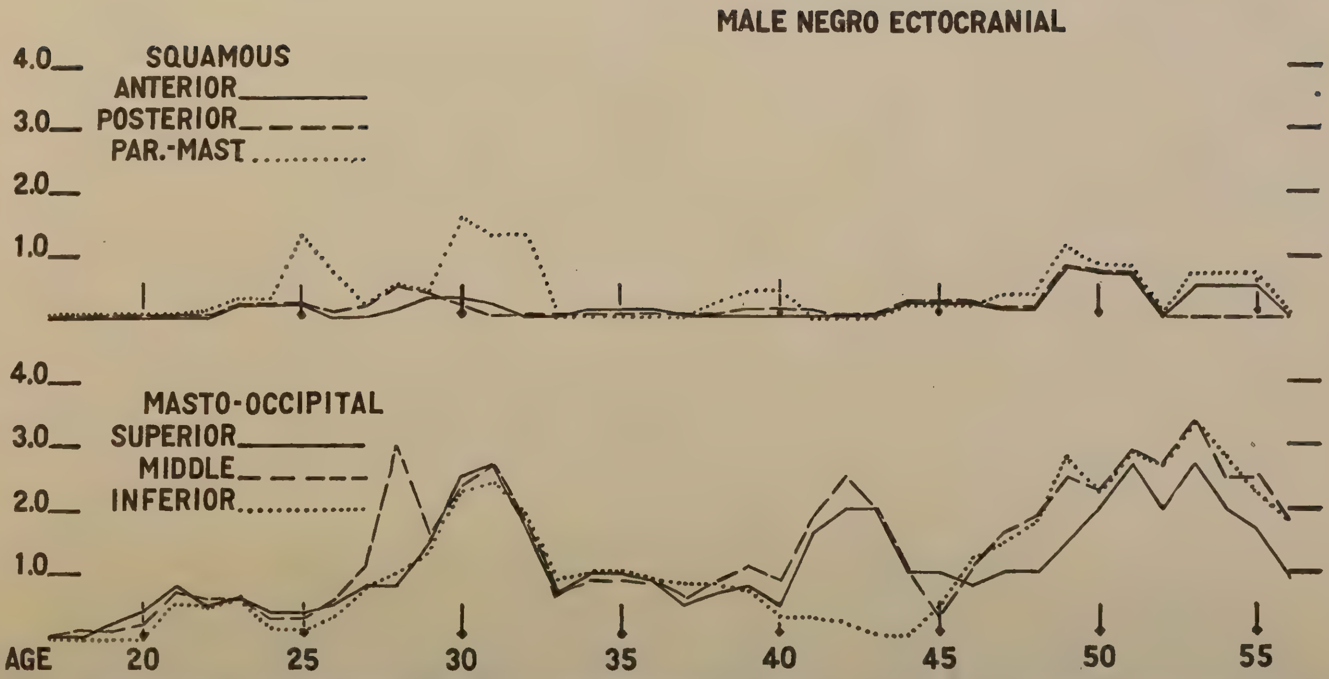


Fig. 2a. Ectocranial closure progress in the circum-meatal and accessory sutures. Progress in all these except the orbital spheno-frontal and masto-occipital is obviously different from that of the vault sutures. The patterns of the inferior masto-occipital and of the spheno-frontal differ from the corresponding endocranial patterns (Fig. 6, 7). Evidence of a subsidiary period of activity appears in these sutures about fifty. Lapsed union is characteristic of all ectocranial sutures.

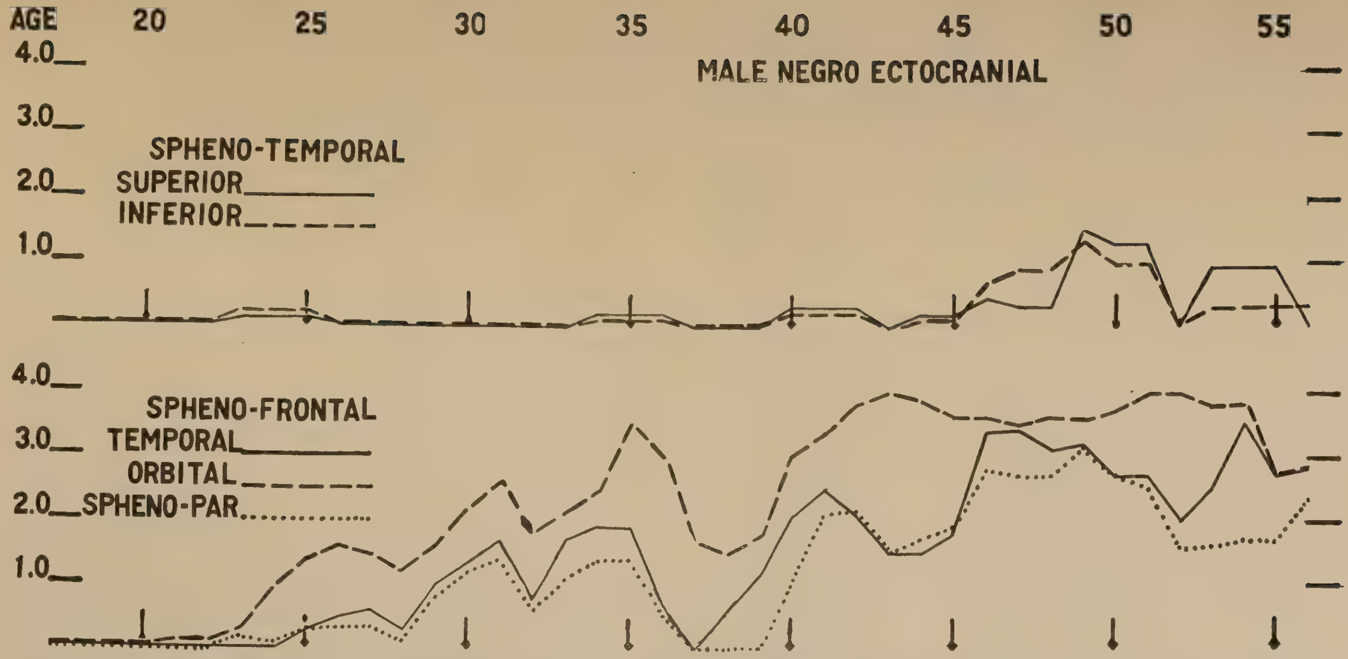


FIG. 2b. Ectocranial closure progress in the circum-meatal and accessory sutures. Progress in all these except the orbital spheno-frontal and masto-occipital is obviously different from that of the vault sutures. The patterns of the inferior masto-occipital and of the spheno-frontal differ from the corresponding endocranial patterns (Fig. 6, 7). Evidence of a subsidiary period of activity appears in these sutures about fifty. Lapsed union is characteristic of all ectocranial sutures.

THE CIRCUM-MEATAL SUTURES

In the White skull emancipation from the usual mammalian pattern of suture closure is clearly marked on the endocranial aspect and in more obscure fashion on the outer face. Ectocranial union in Whites commences in the masto-occipital suture alone during the supreme period of suture-closure activity, namely between twenty-six and thirty years.

This significant delay is not apparent upon superficial examination of either the ectocranial or endocranial surface of individual Negro skulls. A closer study of a sample shows that it is characteristic also of this Stock: it is masked by the determined effort at early union which however succeeds only in the masto-occipital suture. This successful attempt at closure in the masto-occipital precludes one from laying any stress upon the suggestion given by the lambdoid of many individuals that there is a real delay in union of the sutures in the occipital part of the Negro cranium. Were the Negro skull striving to open out in the occipital part some conformity might be confidently expected in the closure patterns of masto-occipital and lambdoid sutures. Critical examination proves that there is none. Of course the evident lapsed union in the lambdoid suture of so many Negroes calls for explanation. So far this has eluded us but the marked individual variation suggests some existing instability or change.

Apart from the masto-occipital other sutures of this group make merely a faint effort at closure before the secondary period of activity at about fifty years.

1. The Masto-Occipital Suture

(Fig. 2)

Extremely early commencement of union of the masto-occipital suture is characteristic of the outer face as it is of the endocranial aspect, but it is spurious in nature and real union only takes place in the later twenties.

In the pars superior closure starts at nineteen years but has reached no more than 0.8 at twenty-eight. From this age to thirty-one union is rapid and at the latter age stands at 2.7 beyond which no further real progress takes place.

In the pars media the first sign of union appears at eighteen and again proceeds very lethargically until twenty-six when it has reached 0.6. There is a spurious rise at twenty-eight but, as in the pars superior union reaches its maximum at thirty-one when it also attains the figure 2.7. In later years the graph shows merely oscillations.

In these two parts of the suture ectocranial closure follows closely the pattern of endocranial union but ceases earlier and does not progress so far.

Comparison with ectocranial union in the White skull reveals no really significant difference. Actually the similarity is quite striking but final union is greater in the Negro.

Our graphs for the Negro do not carry us with confidence beyond fifty-five years but there does seem to be indication in the masto-occipital suture of a secondary period of activity at about fifty years.

In the pars inferior union starts at twenty-one and proceeds slowly until twenty-six when the graph stands at 0.3. After this there is a steady rise to 2.5 at thirty-one beyond which once more progress is oscillatory except for the secondary activity at about fifty years. Commencement is several years later than on the endocranial aspect and there is no distinction between the closure pattern of this part and those of the other portions of the suture as there is on the inner face.

Compared with the White skull we find again a striking similarity of pattern. In both Stocks the graphs of all three parts of the suture follow a very uniform course. The acceleration and final greater degree of union of the inferior part so characteristic of the endocranial face of both Stocks is entirely absent on the outer face.

2. The Spheno-Temporal Suture

(Fig. 2)

Regarding closure of both superior and inferior parts of the spheno-temporal suture there is extremely little to say. Sporadic rises of the graph occur from time to time but there is no real activity until about fifty years and the actuality of activity even then is doubtful. Probably this suture does not close at all.

There is a pronounced attempt at closure on the endocranial aspect in the fifth decade, affecting the inferior portion more than the superior. In this suture the closure influence clearly operates from the inner surface.

In the White skull also there is very little attempt at union ectocranially and what there is scarcely makes its appearance until late in life. The endocranial aspect however resembles the inner face of the Negro skull in attaining a greater and earlier degree of closure.

3. The Squamous Suture

(Fig. 2)

The squamous suture resembles the spheno-temporal in exhibiting merely sporadic attempts at union. While efforts are made in both

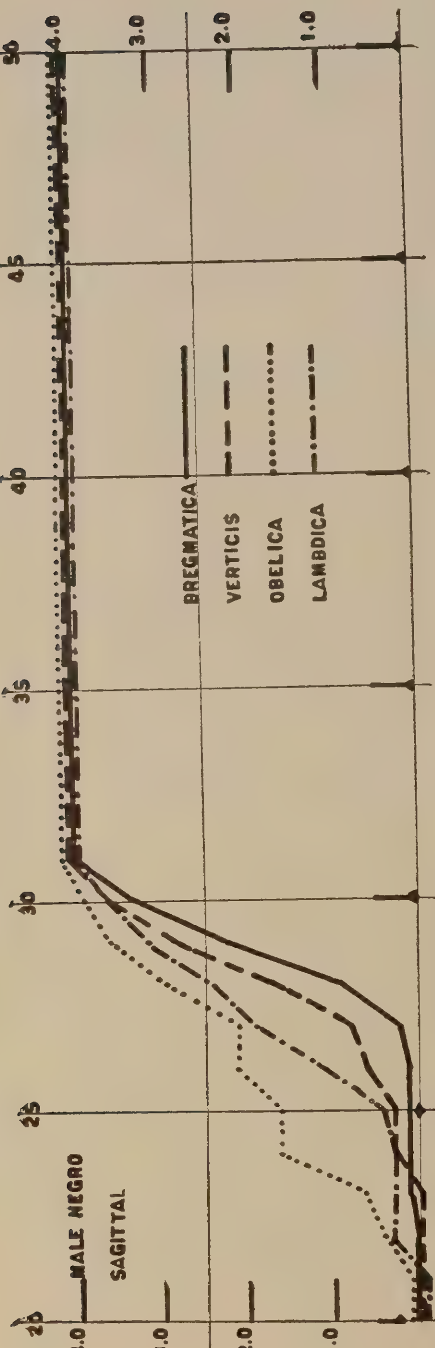


FIG. 3. This and the succeeding four figures of endocranial closure are inserted for comparison. Closure pattern on the endocranial aspect of the sagittal suture. Note the obelica.

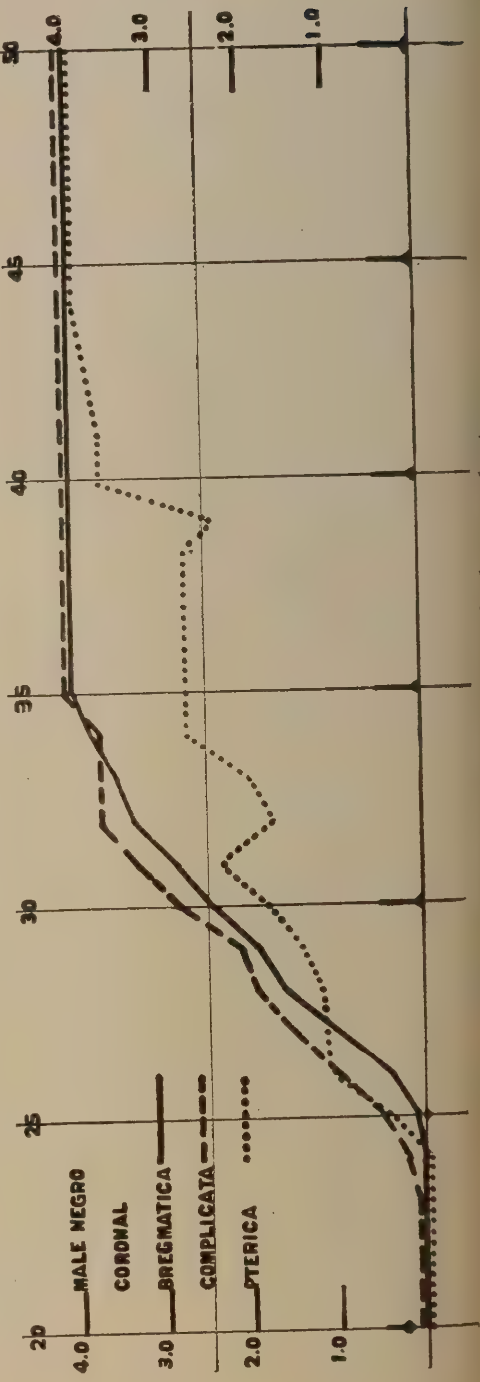


FIG. 4. Endocranial closure progress in the coronal suture.

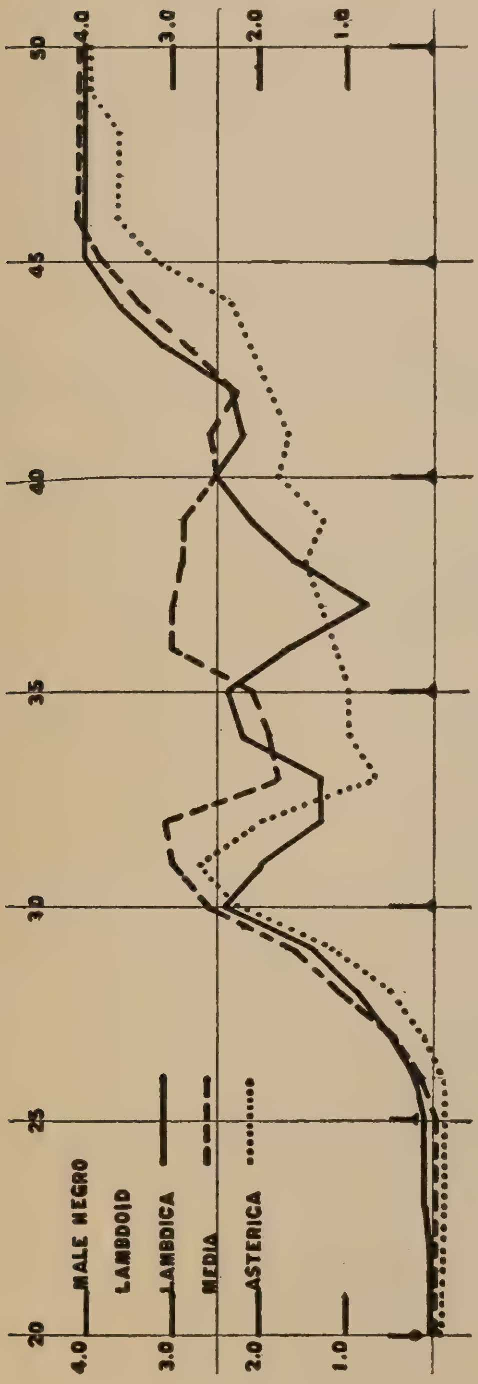


Fig. 5. Endocranial closure progress in the lambdoid suture.

sutures at the age of twenty-three there is nothing noteworthy until fifty years. In the squamous suture this late union is more than a little doubtful. Probably this suture also never closes. The early attempt accords well with the similar early attempt at the same age on the inner face but it is of no significance except to mark a survival of the typical mammalian date of closure. The squamous suture in the White skull presents a quite comparable ectocranial closure pattern.

4. THE PARIETO-MASTOID SUTURE

(Fig. 2)

The closure pattern of the parieto-mastoid suture closely resembles that of the squamous suture of which it is the continuation. The sporadic attempt at twenty-two is not kept up, despite the spurious rises at about twenty-five and thirty years. It never really closes much beyond 0.5. This is not nearly so great as on the endocranial aspect where however closure does not really amount to much until after fifty years. Any differences from the graph of the White skull are probably due merely to random sampling.

THE ACCESSORY SUTURES

As in the White skull the closure patterns of the spheno-parietal and the temporal part of the spheno-frontal sutures run a parallel course. The orbital part of the spheno-frontal pursues a course of its own. This scheme differs considerably from that presented by these sutures on the endocranial aspect of the skull. In both White and Negro series, on this face the two parts of the spheno-frontal suture follow a common closure pattern and the spheno-parietal has an independent course. The explanation is found in the fact that inner and outer aspects of the spheno-frontal suture are not at all comparable and should not therefore be contrasted at all. On the other hand we are justified in comparing the ectocranial patterns of White and Negro Stocks, and as we might expect, we find them strikingly similar.

1. THE SPHENO-PARIETAL SUTURE (FIG. 2)

Union in the spheno-parietal suture commences at twenty-three years and follows closely the pattern of the temporal part of the spheno-frontal. There is practically no progress until twenty-eight and then a rapid rise to 1.4 at thirty-one. Following the curve of the temporal spheno-frontal the stage of 2.8 is reached at forty-six but only after many oscillations and these oscillations continue during later life.

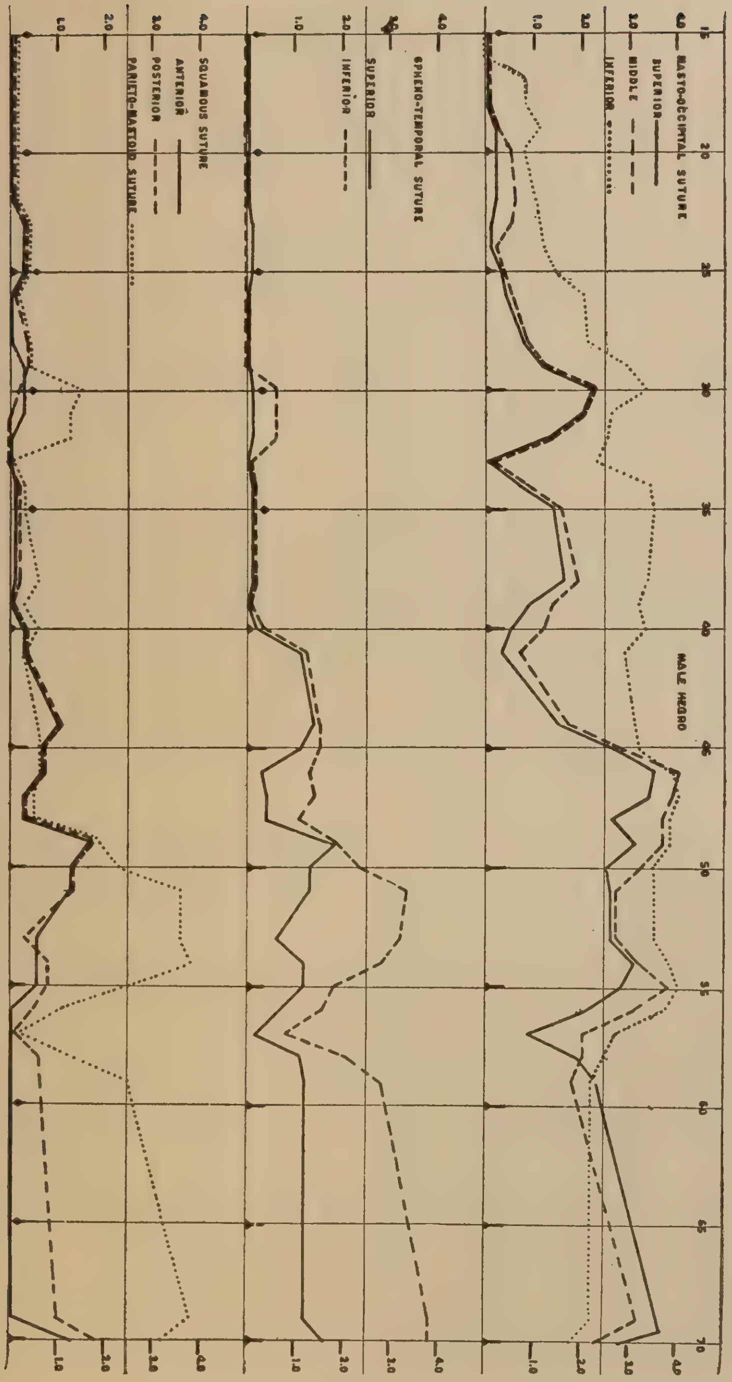


FIG. 6. Endocranial closure progress in the circum-meatal sutures.

2. THE SPHENO-FRONTAL SUTURE (FIG. 2)

The orbital part of the spheno-frontal pursues a course not greatly differing from that of a suture of the vault. This is probably due to the fact that, like the vault sutures, emancipation from the typical mammalian pattern is not so pronounced as in the other parts of the accessory sutures. The temporal part on the contrary, like the spheno-parietal suture, more closely resembles in its course the masto-occipital. As these sutures mark somewhat comparable extremes of the circum-meatal complex this similarity in closure pattern is to be expected.

The orbital part commences to unite at twenty-one and there is a steady rise to 2.6 at thirty-one and to 3.5 at thirty-five. Complete closure is attained at forty-three and sporadically thereafter.

The pars temporalis shows union first at twenty-five and exhibits a steady rise to 1.9 at thirty-five. It reaches 3.4 at forty-six and beyond this it does not progress.

Both parts of the suture exhibit a markedly oscillatory course and in this they resemble the White pattern but are somewhat more erratic. The orbital part in the White skull rises to 2.3 at thirty-one and finally to 3.8 at forty-six years. The temporal part also commences to close at twenty-eight and though progress is slow at first the curve rises to 2.1 at thirty-eight with slow oscillatory progress thereafter. The similarity of pattern in White and Negro Stocks is therefore quite as striking as in other areas of the cranial suture complex

CONCLUSIONS

In discussion of the Negro endocranial sutures we have dealt fully with the method of combing our material. We have mentioned that minor variabilities, not great enough to cause exclusion of the skull from our series, but still large enough to produce marked irregularity in the graphs, are also more frequent in the Negro series. We have not considered it worth while to carry the graphs further than fifty-five years because of the relatively small number of skulls in our collection beyond sixty years of age.

When a comparison is made between Negro ectocranial closure and Negro endocranial union we find that the period of election from twenty-six to thirty years is marked on both surfaces of the cranium by vigorous progress in union of the vault sutures. Shortly after thirty years there is pronounced slowing of the pace on the endocranial aspect and an inhibition so effective on the outer face that little or no further progress takes place. As in the White the coronal suture exhibits an inversion of closure order, the pars pterica taking the lead on the outer face

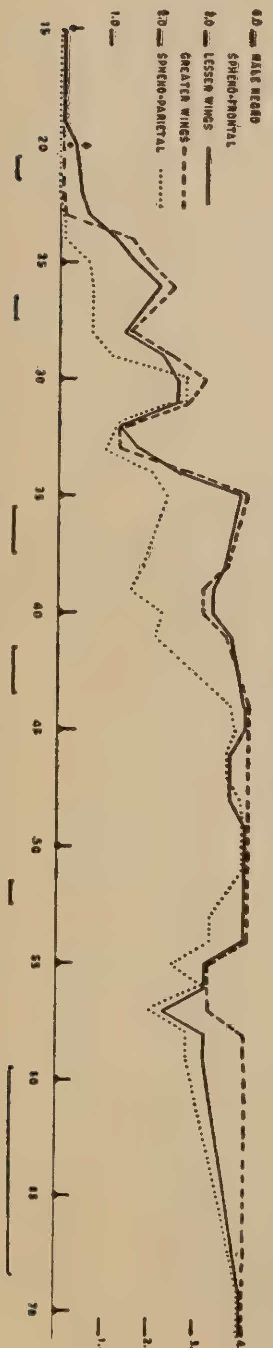


FIG. 7. Endocranial closure progress in the accessory sutures.

whereas it lags behind on the inner surface. The entire lambdoid on the ectocranial aspect is very lethargic in closing and its pars asterica has almost entirely lost the ability to close at all. This is of course a form of lapsed union and represents an extreme type of human emancipation from the mammalian time table of suture union. It is this peculiarity of the ectocranial lambdoid the superficial study of which uncorrected by investigation of the inner face, led Gratiolet and others into the extraordinary and thoroughly baseless view of a difference in closure order between Negroes and Whites. During the period of election the coronal maintains a slight lead over the lambdoid in its closure, precisely as in Whites.

In the circum-meatal and accessory sutures we find a fairly close resemblance to the vault pattern in the orbital part of the spheno-frontal and to a much less extent in the masto-occipital, the spheno-parietal and the temporal part of the spheno-frontal. On the other hand the squamous, parieto-mastoid and spheno-temporal sutures probably do not close at all on the ectocranial aspect. There are therefore the same stages in emancipation in the outer face of the Negro skull as on the inner face, most pronounced emancipation in the squamous suture and less complete emancipation the further one progresses away from this suture as a focus along the circum-meatal and accessory groups and the asterica of the lambdoid.

The significant difference between the ectocranial and endocranial patterns of the spheno-frontal suture has already been emphasized; they are not really comparable at all.

TABLE I. CRANIAL SUTURES—MALE NEGRO ECTOCRANIAL CLOSURE.

Suture	Commencement and course	Termination (or peak)	
Sagittal	20 slowly to 24	32	4.0 in obelica alone 2.9–3.6 in general
Spheno-frontal orbital	21	35 at 3.5	May reach 4.0 at 43
Spheno-frontal temporal	25	46 at 3.4	1.9 at 35
Coronal 1 and 2	22–24	32	Bregmatica at 2.4 Complicata at 1.7
Coronal 3	25	35 at 2.8	Spurious rise at 21
Lambdoid 1 and 2	23 (27)	31–32	Lambdica 2.4 Media 2.0
Lambdoid 3	22 (29)	?31	not more than 1.0
Masto-occipital 3	26	31 at 2.5	Spurious rise at 21 secondary activity ca 50
Spheno-parietal	28	46 at 2.8	1.4 at 31
Spheno-temporal 2	ca 50?	None	Probably never closes
Spheno-temporal 1	ca 50?	None	probably never closes
Masto-occipital 1 and 2.	26–28	31 at 2.7	Spurious rise ca 18 secondary activity ca 50
Parieto-mastoid	ca 50?	None	probably never closes
Squamous posterior	ca 50?	None	probably never closes
Squamous anterior	ca 50?	None	probably never closes

Table II. Cranial Sutures—Male White Ectocranial Closure

Suture	Commencement and course	Termination (or peak)	
Sagittal	20 slowly to 26	29	3.9 in obelica alone 2.4–2.9 in general
Spheno-frontal orbital	28	46 at 3.8	2.3 at 31
Spheno-frontal temporal	28	38 at 2.1	may reach 4.0 in old age
Coronal 1 and 2	26	29	Bregmatica at 2.3 Complicata at 0.9
Coronal 3	28	50 at 3.8	Spurious rise at 22
Lambdoid 1 and 2	26	30	Spurious rise at 21 Lambdica 2.3 Media 1.9
Lambdoid 3	26	?30	not more than 1.0
Masto-occipital 3	26	33 at 1.4	may reach 4.0 in old age
Spheno-parietal	28	38 at 2.0	0.5 at 31: continues to old age
Spheno-temporal 2	36	?65	probably never closes
Spheno-temporal 1	37	?65	probably never closes
Masto-occipital 1 and 2	28	32 at 0.8–1.0	may reach 3.5 in old age
Parieto-mastoid	39	?64	probably never closes
Squamous posterior	38	?65	probably never closes
Squamous anterior	38	?65	probably never closes

In comparing Negro and White patterns on the ectocranial face we find that, in the vault sutures, when one has discounted the difference in total numbers, there is strikingly little discrepancy. In the Negro the graphs of the several parts of any suture tend to run more closely together than in the White and the same slight lead of the coronal over the lambdoid is maintained. The insignificant differences found on the endocranial surface between spheno-temporal, spheno-parietal and masto occipital of Whites and Negroes are not apparent on the outer face. Indeed one would have great difficulty in determining, did one not already know, to which Stock any particular graph refers.

SUMMARY

1. Suture closure in the Negro, as in the White, makes its appearance on both faces of the cranium at one and the same date. There is no significance in such slight differences as occur except in the coronal. The reason for accelerated progress in the pterica of the coronal on the outer surface and its lagging behind endocranially is not yet yet apparent.
2. Ectocranial closure is more erratic, slower and less complete than endocranial union.
3. Lapsed union is very characteristic of all ectocranial sutures though it does not present itself in all individuals.
4. The period of election for suture closure is twenty-six to thirty years just as on the endocranial face. There is evidence however of secondary periods of activity, one about fifty years.

5. Ectocranial closure patterns are the same for both faces of the cranium, allowing for the limitations mentioned above, except in the coronal suture and in the spheno-frontal suture. The appearances of the latter suture upon outer and inner faces of the cranium should not be compared.

6. We repeat that there is one modal of type of human suture closure upon outer and inner faces of the cranium, common to White and Negro Stocks, and that human emancipation from the mammalian type of closure is focussed upon the squamous and its subsidiary sutures and upon the lambdoid.

REFERENCES

1. Todd (T. W.) and Lyon (D. W.)—1924. Endocranial suture closure, Part I. Adult males of White Stock. *Am. J. Phys. Anthrop.*, VII, 325–384.
2. Todd (T. W.) and Lyon (D. W.)—1925. Suture closure, Part II. Ectocranial closure in adult males of White Stock. *Am. J. Phys. Anthrop.*, VIII, 23–45.
3. Todd (T. W.) and Lyon (D. W.)—1925. Suture closure Part III. Endocranial closure in adult males of Negro Stock. *Am. J. Phys. Anthrop.*, VIII, 47–71.
4. Herskovits (M. J.) Variability of Negro family strains (not yet published).

ON THE INCIDENCE OF THE SUPRACONDYLOID PROCESS

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Testut[1] found as the result of his investigation on the supracondyloid process in a series of 929 bodies in the dissecting room at Lyon that the incidence was 1 per cent. The examination by Terry[2] of 683 white patients in a free dispensary, a group of individuals whose intelligence and social status are comparable with Testut's group, gave an incidence for the spur of 0.87 per cent. Hrdlička's[3] figures from over 3000 bones of adult whites, males and females, give the average incidence 1 per cent (0.999) for the process form over 3 mm. in height. This material including the Huntington collection was in large part derived from the dissecting room. Following the paper of Testut, appeared a work by Nicolas[4] ('90) on cadavers of the insane showing a high percentage (5.2) of the process; and in 1899 the study of Ugolotti[5] resulted in an incidence of 11.29 in arm bones of criminals and insane. More recently Zagni[6] ('23) reported an investigation of the variation in criminals with an incidence of 3.5 per cent for the process form; the skeletons of 350 individuals were examined. The question has arisen in consequence of the high incidence in criminals and mental defectives shown in these papers, of a possible correlation between the mental status and the variation under consideration. Recently Cady[7] ('21) investigated 1000 insane patients of the St. Louis Sanitarium. These subjects presented many kinds of mental disorders, a group constituted for testing further this question. Cady's method of examination, previously employed by Terry ('20), was that of palpation of the humerus in the living. The incidence obtained by him was 1.2 per cent.

The present investigation, undertaken at Professor Terry's suggestion, has for its object the determination of the incidence of the supracondy-

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[1] Testut, (L.)—L'Apophyse sus-epitrochléenne chez l'homme. *Internat. Monatachr. Anat. & Physiol.*, 1889, VI.

[2] Terry, (R. J.)—A study of the supracondyloid process in the living. *Am. J. Phys. Anthrop.*, 1921, IV.

[3] Hrdlička, (A.)—Incidence of the supracondyloid process in whites and other races. *Am. J. Phys. Anthrop.*, 1923, VI, 405.

[4] Nicolas, (A.)—Nouvelles observations d'apophyse sus-epitrochléenne chez l'homme *Rev. Biol. du Nord.*, 1890, III.

[5] Ugolotti, (F.)—Sul apofisi sopraepitrocleare dell' omero nei normali e nei delinquenti. *Arch. psich. Sc. pen. & Antrop. crim.*, 1899, XX, 240–248.

[6] Zagni, (L.)—La spina sopraepitrocleare nei criminali. Instituto di Anatomia Umana Normale dell R. Universita' di Modena, 1923.

[7] Cady, (L. D.)—The Incidence of the Supracondyloid Process in the Insane. *Am. J. Phys. Anthrop.*, 1922, IV.

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loid process in physically sound and intelligent people, able to maintain themselves by their own ability and exertions.

Material was obtained in the several departments of Washington University, members of the departmental staffs and the students participating in the investigation by undergoing the examination of the arm. This was conducted in accordance with the method of palpation used by Terry, the discovery of the spur being confirmed by the X-ray. Members of several clubs, clerks, and some private patients (suffering acute diseases) of several physicians were also examined. The following table summarizes the material studied.

TABLE I.

	Males	Females	Total
21 years and over	309	411	720
Under 21 years	34	36	70
			790

DESCRIPTION OF CASES

Observation I. Male. French English extraction. Unmarried; 21 years old. Supracondyloid process right. Form hooked. Position antero-medial. Distance above trochlea 25 mm. Height 7 mm. Strength of pronation r⟩ 1. Supratrochlear foramen. Family living: both parents, one brother, maternal grandmother and several uncles. No processes found among them. Occupation, medical student.

Observation II. Male. American. Scotch English extraction. Unmarried; 23 years old. Supracondyloid process left. Form curved. Position medial. Distance above trochlea 74 mm. Height 7.+ mm. Strength of pronation r⟨ 1. Family living: both parents, three brothers and one sister. No processes found. Three sisters dead. Occupation, medical student.

Observation III. Male. American. German extraction. Unmarried; 25 years old. Supracondyloid process left. Form hooked. Position medial. Distance above trochlea 68 mm. Height 6.5 mm. Supratrochlear foramen. Strength of pronation r⟩ 1. Family living: both parents, one sister and several uncles. No processes discovered. Occupation, medical student.

Observation IV. Male. Italian. Unmarried; 21 years old. Supracondyloid process right. Form hooked. Position medial. Distance above trochles 65 mm. Height 11 mm. Occupation laborer. No other data have been available up to time of writing.

Of the 790 people examined 4 presented processes: an incidence of 0.50 per cent. If adults alone are considered (720) the figure of those having the variation rises to 0.55 per cent. It has been pointed out by both Terry and Cady that since the variation has been found in children, the newborn and in the foetus, groups including children may with propriety be used for calculating incidence. Testut's group included some subjects under 21 years since two cases (one of 11 and one of 13 years) were described as having the variation. If the results are compared after including children we find the incidence for the dissecting room and dispensary groups of Testut and Terry to be 1 per cent and 0.86 per cent respectively; for the physically sound and intelligent group 0.50 per cent, a considerably lower figure. Comparing only adults, the incidence stands: dispensary group 1.16 per cent; insane group 1.2 per cent; Hrdlička's group, chiefly from the dissecting room, 1.0 per cent; sound and intelligent group 0.55 per cent.

Our investigation was confined to adults as much as possible in order that the evidence bearing on the subject's ability to maintain himself and upon his degree of intelligence would not come into question. Very few laborers were included in the test and these only because they were persons of known exceptional ability. Search among the living relations of the subjects for evidences of hereditary tendency has so far revealed nothing in the present study.

THE RELATIONSHIPS OF THE MICROSCOPIC STRUCTURAL CHARACTERS OF HUMAN HEAD-HAIR

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From studies of the relationships of the various structural units of the hair-shafts of mammals below the *Hominidae*,[1] it has been shown that the forms of these units are characteristic rather of the diameters of the hair-shafts in which they occur, than of the species of mammals bearing the hair. The elements which are so related are the cuticular scales and the medullas; the cortices showing no such relationships. The pigment granules (to which the colors of the hairs of the *infra-hominid* mammals are chiefly due) are related to the color of the hair, and secondarily to species, as was pointed out in an earlier study by the writer.[2]

While scale and medulla-form are shown to be intimately related to the diameter of the hair-shaft, in a general way, it can still be said that specific and group characteristics of the minuter configurations in these two structures exist, however; characteristics of sufficient magnitude to be useful to the trichologist.[3]

The hitherto unsuspected relationships between the hairshaft diameter and its structural units, which the studies referred to have revealed, suggested that investigations be undertaken of the status of these same elements in the head-hair of the various races of mankind. Accordingly a collection of scalp-hairs, representative of all the existing races of man, was made from various sources[4] and a comparative study of their cuticular scales and medulals made. The results of this study are here presented.

According to the writer's classification of the cuticular scales of mammalian hair[3] the scales of the human hair-shaft fall in the *flattened type* category, and like the scales of the *infrahominid* hairs, vary, in a general way, inversely with the diameter of the shaft (Fig. 1). This is significant, for it means that scale-forms are, therefore, unrelated to

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[1] Hausman, L. A., Further Studies of the Relationships of the Structural Characters of Mammalian Hair. *Am. Nat.*, 1924, LVIII, 544.

[2] *Ibid.*, Hair Coloration in Animals. *Sci. Mon.*, Mar. 1921, XII, 215.

[3] *Ibid.*, Structural Characteristics of the Hair of Mammals, *Am. Nat.*, 1920, XLIV, 496.

[4] The writer is greatly indebted to the following persons for sending him samples of hair, and hearty thanks are here given them:—First and especially, Dr. Aleš Hardlička then, Dr. Chi Ping, Dr. Arnold E. Lundie, Prof. E. W. Stafford, The Metropolitan Museum of Art, Dr. T. C. Nelson, Dr. H. D. Reed, Dr. A. L. Kroeber, Dr. F. G. Speck, and others.

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race. For example it was found that the scales varied on contemporaneous hairs from the same head, and on hairs from the same head at different periods of life, when the diameters of these hairs varied. Moreover differences exist along the same hair, from base to tip. Many *infra-hominid* hairs show this same characteristic much more strongly marked. An extreme instance of this change in structural character from the base to the tip of the hair, involving not only the cuticular scales, but the other elements of the hair-shaft structure as well, is furnished by the protective, or over-hair of the Platypus (*Ornithorhynchus anatinus*).[5]

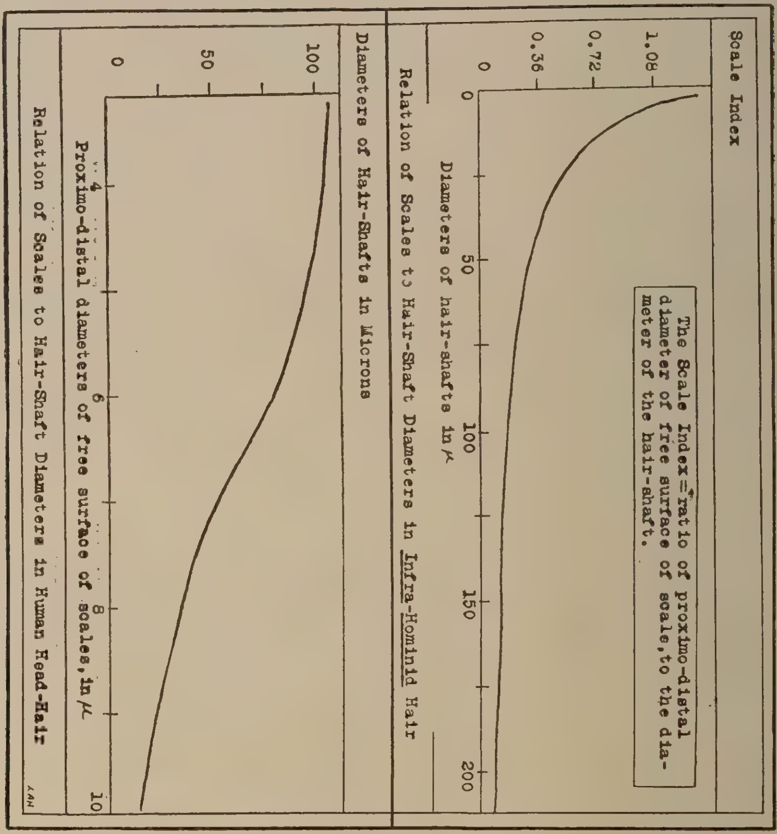

FIG. 1. Relationships between the cuticular scales and the hair-shaft diameters as shown *on left* by 94 specimens of human head-hair, representing all the existing races of mankind,[8] and *on right* by 182 specimens of hair of *infra-hominid* mammals, representing all the existing orders except the *Cetacea*. In each group the tabulation represents the status of the cuticular scales midway between the base and the tip of the hairs.

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[5] Hausman, L. A., A Micrological Investigation of the Hair-Structure of the *Monotremata*. *Am. J. Anat.*, 1920, XXVII, 463.

Such changes are explainable from the behavior of the epidermal cells at the base of the hair follicle. When a hair is about to be shed[6] the papilla atrophies, and the bulb of the shaft becomes cornified. Growth ceases, and the hair-shaft is carried outward toward the mouth of the follicle by the continued proliferation of the cells of the root-sheath. A new papilla now develops, and soon becomes surrounded by the cells forming the bulb of the new hair. The early proliferation of the cells forming the tip of the new hair produces a shaft of less diameter than that which succeeds. When the papilla begins to lessen its mitotic activity—preliminary to atrophy—the shaft of the hair becomes smaller. Hence hairs very frequently show a pointed tip, a broader middle portion, and a narrowing base. The average life of a continuously growing human scalp-hair (that is, the period during which there is uninterrupted mitosis of the hair-forming cells at the base of the follicle) is said to be between five and six months.[7]

Human head-hairs show but one type of scale, as has been said, the flattened type, with almost no variations. This is interpreted as being the cuticular scale indication that mankind is a single species. No variations in this type of scale, analagous to the specific (and varietal) differences to be found in the *infra-hominid* hairs, were encountered.

The medullas of human head-hairs varied also, and again, like the cuticular scales, with the diameter of the hair-shafts, and not with race.[8] Fig. 2 records the results of the study of 122 specimens of human scalp-hair, representing the five races of our table.[8] The greater number of the finer hairs lack rather than possess a medulla, and the greater number of coarser hairs possess one rather than lack it. Intermediately sized hairs bear the various types of the fragmental medullas shown in the figure.

It is interesting, and significant from the standpoint of what has been said regarding the close parallelism between the scale and medulla form

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[6] Unna, P. G. Beiträge zur Histologie u. Entwicklungsgesch. d. Menschl.Oberhaut, etc. *Arch.* mikro. *Anat.*, XII, 1876, 665.

[7] Stöhr, Textbook of Histology.

[8] The following ethnographic classification has been used by the writer, and is to be regarded by the reader, as no more than a convenient check list:—

I. European
    1. South Mediterranean Branch
    2. North " "
II. African
    1. Negrillo Branch
    2. Negro "
    3. Negroid "
III. Asiatic
    1. Sinitic Branch
    2. Sibiric "
IV. American
    1. Northern Branch
    2. Central "
    3. Southern "
V. Oceanic
    1. Negritic Branch
    2. Malayic "
    3. Australic "

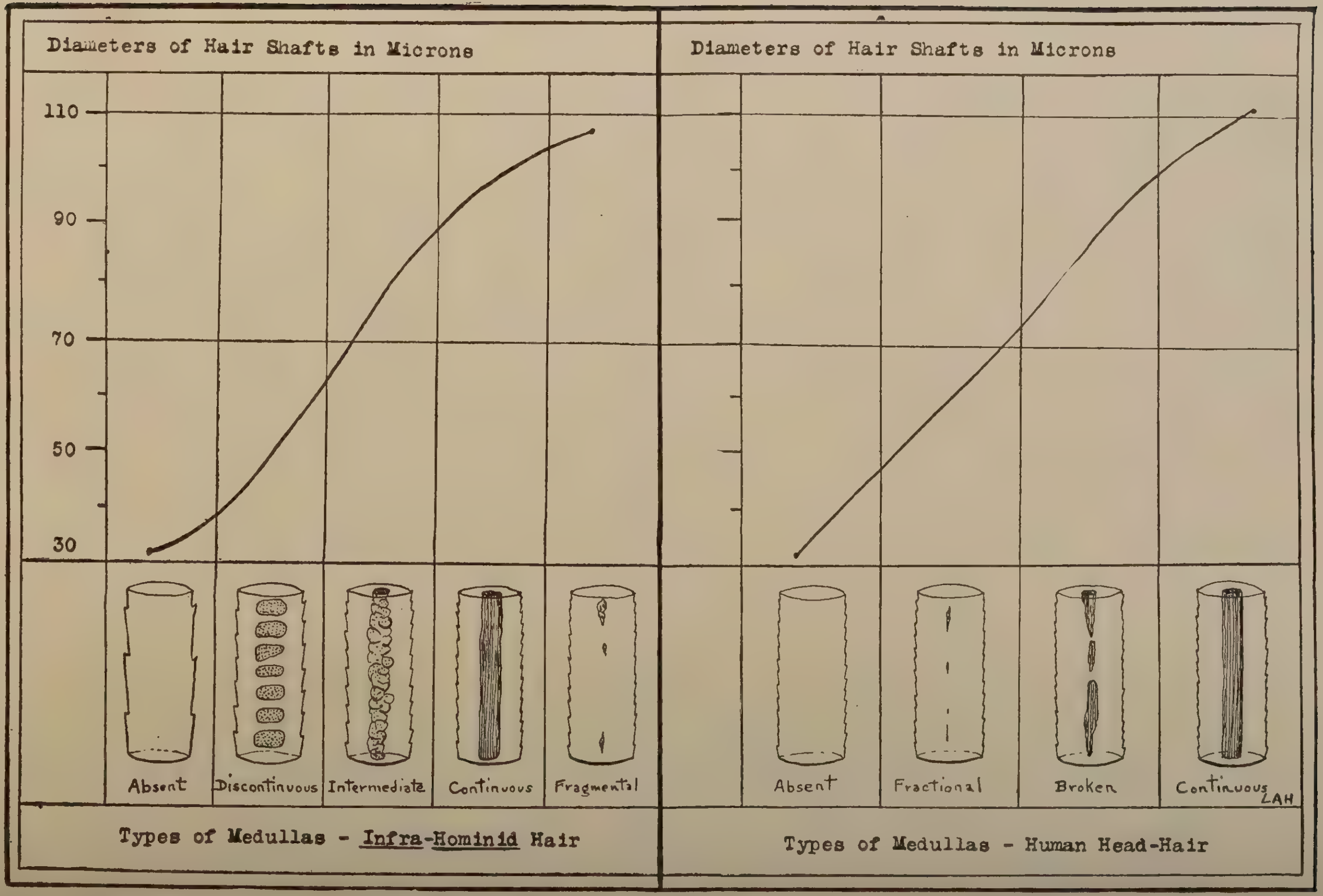

FIG. 2. Relationships between the types of medullas and hair-shaft diameters as shown *on the left* by 182 specimens of *infra-hominid* mammal hairs, representing all the existing orders except the *Cetacea*; and *on the right* by 122 specimens of human head-hair, representing all the existing races of mankind.[8] In each group the tabulation represents the status of the medulla midway between the base and the tip of the hairs.

and the diameter of the hair-shaft, to note what a comparison of these two curves reveals: (1) that in both groups the hair-shafts of about 100 microns[9] in diameter bear virtually the same type of medulla, and (2) that the *hominid* hairs do not show the *discontinuous* or *intermediate* types exhibited by the *infra-hominid* species.[10] From the studies of the finest hairs of very young chilfdren, from the newly born, and from *foeti* (hair-shafts ranging in diameter from 10 microns, in the case of *lanugo*, to 30 microns) it was found that in the great majority of cases the medulla was absent. It is noteworthy, therefore, that in the case of the *infra-hominid* hairs the medullas begin to appear (in the forms of the *discontinuous* and *intermediate* types) when the hair-shafts have attained the diameter of about 15 microns; while in the *hominid* hairs they do not appear until the hair-shaft has reached a diameter nearly twice as great.

The fact that the human hairs do not exhibit the *discontinuous* or the *intermediate* types of medullas (those types which are so frequently encountered in the hairs of the *infra-hominid* mammals) and furthermore the fact that they show virtually no modifications away from the types as shown in Fig. 2 is to be understood, it is believed, as being the medulla-form expression of the unity of the human species.

SUMMARY

The cuticular scales and medullas of the human head-hair are related, as are the same elements in the hair of the *infra-hominid* mammals to the diameters of the hair-shafts in which they occur.

These elements cannot, therefore, be regarded, as being characteristic of race.

Human head-hairs have not been found to show any but one type of scale, the *flattened* type, nor any but the *continuous*, and the varieties of the *fragmental* medullas. These elements do not show any of those characteristic differences of form which have been interpreted as being specific or group differences among the *infra-hominid* mammals.

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[9] 1 micron equals 1/1,000 mm., or about 1/25,400 in.

[10] Many of the *Primates* show the *discontinuous* and *intermediate* types of medullas.

DENTAL PATHOLOGY OF INDIAN TRIBES OF VARIED ENVIRONMENTAL AND FOOD CONDITIONS[1]

R. W. LEIGH, A.B., D.D.S.,[2]

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I. Introduction
II. Tribes
III. Method
IV. Dental Characteristics
V. Attrition
VI. Dental Caries
VII. Periapical Abscesses
VIII. Periodontoclasia
IX. Other Lesions and Notes
X. Summary

I

Reliable data on comparative human dental pathology are meagre. Close observation and comparison of the dental conditions of various races living under widely varying environmental and food conditions are not only instructive but potentially of no mean value. While pursuing studies on the incidence and pathogenesis of dental caries, a need was felt for observation on the teeth of races far removed from our own time and habits.

At the instigation of Dr. Aleš Hrdlička of the Smithsonian Institution this study of dental pathology in certain Indian tribes was undertaken. Systematic study was possible because he placed at the writer's disposal a large series, for the first time available, of well identified crania in excellent condition. I have to thank Dr. Hrdlička for this opportunity as well as for helpful guidance in the work and correction of manuscript. These crania were of tribes living before the influence of white culture, and with modes of life as well as food showing important differences.

II

The following tribes were chosen: 1. An Algonquin tribe living in Kentucky; 2. Sioux; 3. Arikara; and 4. Zuni.

The Kentucky Indians[3] were a sedentary people, living in a restricted locality, and followed the occupations of hunting, fishing and cultivation of gardens and small fields. Maize, squashes and probably beans were

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[1] This study is based on examination of crania in the Division of Physical Anthropology, National Museum.

[2] Captain, Dental Corps, U. S. A.; Instructor in Pathology, Army Dental School; Associate Professor of Pathology, Georgetown University Dental School, Washington, D. C.

[3] Remains collected with exemplary care in a large burial site at the "Indian Knoll," Green River, Ohio Co., Kentucky, by Mr. Clarence B. Moore.

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the principal plants cultivated and with fruit doubtless served as the staple articles of their diet. There is no indication that the tribe had contact with Europeans. Sixty-six crania comprised this first group.

The Sioux were nomads; they were hunters par excellence, and were nearly wholly meat eaters. These people inhabited the great plains and depended almost entirely on the buffalo and other game animals for their living. The buffalo entered very deeply into their whole lives. The Siouan diet was bison meat in some form or other the year round. They cured the meat by drying and prepared a conserved and easily transportable preparation called pemmican, by mixing dried pounded bison meat with indigenous wild berries, pits and all, and preserved the same by sealing with melted fat. Some of the indigenous fruits and bulbs which were used as secondary foods to supplement their limited diet of meat were the wild cherry, plum, strawberry and the prairie turnip. The Sioux necessarily had to make seasonal migrations with the bison, and they utilized the cache to make their food available in these movements. Their physiques attest the healthfulness of their mode of life and diet. The Sioux Indian was truly a rover, and his subsistence and culture were closely adapted to the limited fauna and flora of the wide, open region which he inhabited. The introduction of the horse in modern times brought in a new epoch in the life of the plain's tribes, facilitating their migratory movements and the pursuit of the buffalo, and doubtless contributed to the ultimate extinction of that animal. The ninety-two crania in this group were of the Sioux who lived in early post-Columbian to recent times but whose mode of life had not been influenced by the white race.

The Arikara were a branch of the Sioux; they inhabited the upper Missouri valley. In mode of life however they were semi- or near-sedentary, living in villages and cultivating the soil to some extent, raising maize, beans and squashes. The Arikara are described as "corn eaters" in the Indian sign language. They cultivated a small-eared corn, said to be nutritious and much liked. They bartered corn with the Cheyenne and other tribes for buffalo robes, skins and meat, and exchanged these with the traders, in recent times, for articles of commerce. The Arikara hunted the buffalo in winter. Fishing by means of basket traps was also engaged in. The Arikara accordingly enjoyed a mixed diet. In regard to their mode of preparation of corn for food the significant statement that "mortars for pounding corn were made with much labor from stone," is noted in the Handbook of American Indians. Not only has the silicious covering of the kernel an abrasive effect on the teeth, but sharp particles of stone from the mortar would be inextricably mixed with the meal and would exert a wearing effect upon the teeth. One hundred twenty-nine crania of the Arikara from their village sites near Mobridge, S. D., were examined; these skulls were from early post-Columbian to recent times.[4]

The old Zuni are represented by a group of one hundred thirteen crania from the ruined Pueblo Havikuh, excavated by F. W. Hodge. These people lived in a late pre-Columbian to early post-Columbian epoch; their first contact with Europeans was with Coronado's expedition in 1540. But their mode of life and food habits were uninfluenced by this contact. The Zuni are characterized as a sedentary agricultural people. They lived in permanent settlements, the compact pueblos. Their houses are communal, generally but one structure for the whole village. The Zuni represent well the pueblo culture which was one of the highest attained north of Mexico. They were not only intensive agriculturists, but were skilful in basket-work, weaving, pottery, and had highly developed ceremonial customs. The small fields of the Zuni were irrigated from living streams or reservoirs. Their chief crop was maize, but pumpkins, beans, etc., were also cultivated. Their diet was largely vegetarian; but in addition to their agriculture, the Zuni hunted to some extent the deer, rabbit and turkey. The latter was domesticated. But meat of any sort was a smaller part of the diet. Piki or maize bread made in thin spreads was the staple. The mode of life and food of the Zuni are more closely related to our own civilization than that of any of the other tribes here considered.

III

Naked eye examination of the skulls in good light, with the occasional aid of a fine explorer and micrometer, was made. All observable lesions in the teeth themselves as well as the paradental bone were recorded; peculiar morphological characteristics were also noted. Most of the lesions were amenable to classification under the following dental pathological processes: malocclusion, attrition, dental caries, pulpal exposure and necrosis, periapical abscess, periodontoclasia, developmental dystrophy, supernumerary and atypical teeth. Notes were made on additional osseous lesions and anomalous conditions.

A simple form providing an appropriate notation for the thirty-two teeth in the series was utilized; ample space opposite a number representing each tooth, in connection with a short symbol for each pathological process, enabled accurate and rapid recording. The sex, and the age, estimated within a decade, were also noted. A separate card with tribal name and catalogue number was used for each skull. The four groups comprised four hundred crania in all examined.

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[4] The larger part of this excellent material was collected for the National Museum by Mr. M. W. Stirling, of the Museum.

IV

Marked differences were found in the incidence of the various dental diseases in the four tribes. These differences can doubtless be correlated with the mode of life, occupations, physical inheritance and food of the people.

The dental arches of the Kentucky tribe are well developed and usually broad and, as shown by Hrdlička, the teeth also are unusually broad. One strikingly peculiar morphological feature is the contour of the approximal surfaces of the premolars and molars. Instead of these showing well rounded approximal surface with small contact, as usually obtains in the white race, the teeth present a concavo-convex surface with broad contact. In cross section an open S is described; the convex aspect of one tooth comes in close contact with the concave aspect of the approximating tooth and the concave area of the former with the convex area of the latter. This gives an interlocking effect, viewed from the occlusal surface, as is characteristic of many mammals. Some specimens had a very broad flat contact surface.

The marginal ridges of the upper incisors are unusually well developed, present a rounded elevation surrounding a roughly triangular deep concave central fossa on the lingual aspect. This feature occurred quite constantly in all four tribes, and appears to be a universal physical characteristic of the American Indian. This feature has been extensively studied and described by Hrdlička under the description of shovel-shaped teeth.

With regard to occlusion, the adults of the Kentucky group almost invariably presented an edge-to-edge occulsion of the incisors,but nearly if not quite normal mesio-distal relation of the upper and lower first molars was maintained. In the skulls of children the normal overlapping of the upper incisors obtained. There were no cases of malocclusion involving an abnormal mesio-distal relationship of the jaws as determined by the relation of the upper and lower first molars. A condition of malocclusion occurring with more or less frequency in all Indian crania is a peculiar torso-occlusion of the upper central incisors: the mesial angles of both teeth are depressed lingually. This condition occurred in five per cent of cases in the Kentucky group. Often there is a similar arrangement of the lower central incisors. No evidence was present in the cases examined of prolonged retention of deciduous teeth acting as the etiological factor of malocclusion. There were cases of suppression of both upper and lower third molars; impaction of lower third molars occurred in ten per cent of cases.

The dental characteristics of the Sioux elicit considerable admiration; the teeth are large, well formed and remarkably free from both developmental and acquired diseases. The alveolar process, in harmony with the whole osseous system, is thick and vigorous. The crests of the alveoli are better defined and approach nearer the enamel margin than in any of the four tribes. The buccal plates covering the roots are much thicker than in other races. The jaws are unusually large and heavy; the body of the mandible in most cases is thick, the rami large and the condyles and coronoid processes large and prominent. The cusps of the teeth appear long, and the grooves and sulci of occlusal surfaces are free from faults.

Occlusion is normal in a high percentage of cases. The upper central incisors overlap the lower incisors in a greater number of cases than in the other tribes, yet there are more than fifty per cent with an edge-to-edge arrangement of the incisors. There is a type of Class I (Angle) malocclusion which is characteristic of this and some of the other tribes: either first or second upper premolar is in torso-occlusion; the tooth is rotated mesially ninety degrees, and this position apparently has been assumed because of an over-size space for these teeth. In the Sioux this condition occurred in five per cent of cases. In this group there were only two instances of impaction, one an upper right cuspid, the other a lower right third molar. The abnormal position of the cuspid had been brought about by prolonged retention of the deciduous cuspid.

The Arikara had arches and teeth similar structurally to those of the Sioux. The teeth are large; the incisors particularly are broad, often the upper lateral incisors are so broad as to simulate central incisors. One central incisor measured 9.5 mm. in width. Very often a groove extended up the root of the lateral incisors, marking the line of fusion of the two lobes. The marginal ridges as well as the cingulum of the upper incisors are prominent. The approximal contact is broad.

With regard to occlusion, there is no instance in this tribe of an improper mesio-distal relationship of the arches as determined by the relationship of the lower to the upper first molars. One specimen presented an extreme labial overlapping of the upper incisors in which function had produced marked lingual attrition of the uppers, and labial attrition of the lower incisors. As in the Sioux and Zuni, ninety-degree rotation of either first or second upper premolars occurs in about ten per cent of cases; and also several cases of the characteristic lingual depression of the mesial angle of the upper central incisors. Occasionally the lower incisors are in torso-occlusion. There were six cases of impacted lower third molars, and two of impacted upper right cuspids.

The teeth of the Zuni are smaller than those of the other tribes, but their size is in harmony with smaller statures, skulls and maxillae. The racial habit of occipital compression of the skull may possibly have influenced the shape of the arches. The alveolar process is much thinner than in the other tribes and the crest apparently does not reach as near the enamel margin. The second and third molars seem especially small, and in many cases the third molars are diminutive. The mandibular incisors are often very small. Because of under-size teeth diastemata sometimes occur between them.

The Zuni presented no case of disturbed relation of the upper and lower arches. The characteristic torso-occlusion of the upper central incisors occurred in nearly ten per cent of cases. There are no impactions of lower third molars; this is possibly accounted for because of their small size. In many crania the third molars are absent and it is not certain whether they were suppressed or had been lost early.

The Zuni denture is the smallest and least perfect of any tribe, and there is evidence of involution. Superimposed upon rather inferior dentures is a high incidence of acquired dental diseases.

V

Attrition is the gradual wearing away of the hard parts of the teeth through the physical and physiological agencies of mastication of food. Mastication of narcotics, sometimes mixed with silicious alkalies, may conveniently be included in the foregoing definition, although the latter invariably assumes pathological import. Attrition is an accompaniment of senility in which it is fairly generalized. The degree of attrition may conveniently be classified as follows: first degree is that stage of wear in which the enamel of the cusps is worn without exposure of the underlying dentin; second degree is characterized by obliteration of the cusps with partial exposure of the dentin but still showing enamel at the bottom of grooves; in third degree the tooth has been considerably shortened, even approaching the neck, completely exposing the dentin; fourth degree attrition exposes the pulp. The wearing away of the maxillary teeth frequently takes place on an obtuse plane, one end terminating at the linguo-cervical margin; in the mandibular teeth concave areas frequently are worn, or in advnaced cases an obtuse plane is formed which slants to the bucco-cervical margin. In more advanced cases the plane on the upper teeth is shifted to the buccal. In senile individuals with advanced attrition, there is a buccal displacement of the apices of the teeth following resorption of the buccal plate of the alveolar process, with eventual buccal exfoliation of the worn down roots. This is a characteristic accompaniment of generalized senile atrophy.

The outstanding dental lesion of the Kentucky tribe is an early generalized attrition which becomes destructive in middle life. In the skull of a nine year old child, in which the second deciduous molars are present, the extreme early wearing of the teeth is exemplified. The deciduous molars show third degree attrition, and the first permanent molars, having been erupted only three years, show first degree attrition. In one senile case eleven pulp exposures with an equal number of alveolar abscesses resultant therefrom were observed. The writer has never seen lesions of attrition so generalized, developed so early in life and with such far reaching pathological results as in the crania of these Kentucky people. Over fifty per cent of the dentures exhibit third to fourth degree wear. In all there are one hundred forty-eight pulp exposures through attrition with an equal number of periapical osseous lesions resultant from pulpal necrosis. The only tooth in the series whose pulp was not exposed through attrition is the upper lateral incisor; this, no doubt, is because of its shorter length. The upper first molars suffered most with a total of thirty-nine exposures; this number is more than twice that of the lower second molar which had the next larger number of exposures.

Were it not for the fact that teeth usually form secondary dentin on the pulp chamber wall subjacent to the wearing surface, there would be more teeth with pulp exposures. In most races the rapidity of wear is slow enough to enable the pulp to entirely protect itself by the formation of new dentin. Dr. Julio Endelman, a well known writer on dental pathology, states that teeth, although worn to the cervix, never have their pulps exposed because of the constant building in of secondary dentin. This observation accentuates the extreme early rapid wear which occurred in the teeth of this prehistoric tribe. When attrition is so generalized and well advanced even in childhood, there is but one cause to which it can be attributed, and that is the character of the food, including the possibility of chewing some habit-forming substance. Not only is maize in itself abrasive but it was doubtless prepared by grinding on stone from which many fine sharp particles became mixed with the food, and the same would have a destructive abrasive effect on the teeth. Occlusion is almost universally normal and, therefore, the arrangement of the teeth can not be a contributing factor with this tribe; also the physical character of the enamel and dentin are perfectly normal and, therefore, the advanced wear cannot be attributed to a subnormal density or abnormal chemical composition.

Nor was pulp exposure with consequent abscess the only deleterious effect of attrition. When the teeth became worn beyond their convexity, the approximal contact was removed and open diastemata presented, with consequent interstitial impaction of food; and the latter, in turn, brought about inflammation and atrophy of the supporting alveolar tissues, as well as a tendency to initiate dental caries at the cervix.

The teeth of the Sioux, in marked contrast with those of the Kentucky tribe, show the least attrition of the four tribes. Functioning on a meat diet did not produce appreciable wearing of the occlusal surfaces until after fifty years of age. The prominent cusps were often apparent beyond middle life. Trituration of the food was not a habit with these people but rather only an up and down motion was used. Twenty-six per cent of Sioux crania, practically all senile, evidence third to fourth degree wear. In all cases of third degree attrition there is well formed secondary dentin following the line of recession of the pulp; and the new formation is conspicuous by a somewhat darker color than that of the primary dentin. The facility with which perfect secondary dentin was formed may have a correlation with an especially nutritious diet. In several teeth, split post mortem, secondary dentin is evident filling almost completely the pulp chamber. However, there were fourteen senile individuals who suffered twenty-two pulp exposures from attrition which invariably resulted in alveolar abscess. About one-third of the total exposures were in upper first molars.

There is conspicuous attrition of the teeth in the Arikara, even of the deciduous series. Thirty-seven per cent of the specimens show from third to fourth degree wear. There are eighty-five pulp exposures through attrition, most of which are in persons of advanced years. Generalized attrition is greater only in the teeth of the Kentucky tribe than in the teeth of the Arikara. The Arikara, it should be borne in mind, are sedentary Sioux.

The teeth of the Zuni show moderate wear. Evidently their diet, though largely vegetarian, did not require mastication sufficient to bring about wear early in life, or else abrasive qualities were somewhat lacking in it. Twenty-one per cent show third to fourth degree attrition; this is twice that of the Sioux but less than that of the two other tribes. Forty-three pulp exposures resulted.

In many Zuni men there is an undue wear of the lower incisors. There is evidence that this wear was not produced by occlusal contact with the upper incisors. Rather than physiological wear the destruction may have resulted from friction set up by some foreign body, such as some object held in the mouth in connection with some craft. The wear is similar to that produced by pipes. Twenty-four pulp exposures were produced through wear of the lower anterior teeth.

VI

Dental caries is infrequent in the teeth of the Kentucky tribe. In the entire group of skulls there were only twenty-eight small lesions, which were confined to thirty per cent of cases. Of the thirty-two teeth in the series only eleven were attacked by caries. There were only two susceptible areas: (a) sulci or pits on the occlusal surface and the buccal pit of lower molars; and (b) exposed cementum or dentin at the cervix, following atrophy of the gums. Sixteen of the lesions were located on exposed cervices. The exposure of the cervical cementum or dentin was subsequent to marked attrition, loss of approximal contact, or loss of teeth. There are no cases of caries in children or young adults, but the few lesions occurred in persons well advanced in life. This localization and period of occurrence justifies the appellation senile caries.

The Sioux are by far the least susceptible to caries of the four tribes. Caries is almost negligible; of the ninety-two crania there are but ten with carious lesions most of which are quite simple. There is but one case of pulp exposure with resultant alveolar abscess, that being an upper first molar.

In a senile Sioux skull there are disto-cervical lesions on the upper first and second molars which have the characteristics of erosion rather than caries: a narrow clean-cut furrow extends across the surface and the exposed dentin is uncolored.

The incidence of caries in the Arikara is considerably higher than in the teeth of the Sioux proper. Twenty-eight per cent of crania exhibit one or more carious lesion, most of which, however, are comparatively simple—in all eighty-six cavities. In several instances there is a bilateral localization on the like surface of the corresponding tooth. Fully fifty per cent of the lesions had their initiation at the cervix on approximal surfaces.

Dental caries in the Zuni is present in seventy-five per cent of the skulls. This is far above that in the other tribes, and is an incidence comparable to that in modern white people. The twenty-five per cent of crania which are free from caries are mostly children or sub-adults. There are two cases of caries of deciduous teeth. Caries appeared to develop to some extent fairly early in life in pits and fissures on the occlusal and buccal surfaces; but the greatest occurrence of caries had its initiation again on the susceptible exposed cementum or dentin at the cervix, subsequent to recession of the gums. Beginning at the cervix the lesions extended occlusally as well as toward the pulp. The incidence of caries increased with age on this highly susceptible area; therefore, cervical caries is properly referred to as senile dental decay. Invariably lesions occurring on approximal surfaces began cervically from the enamel margin. Atrophy of the gingiva permits interstitial impaction of food with resultant caries. Over sixty per cent of the total lesions began at the cervix.

The Zuni diet apparently tended to leave tenacious debris upon the teeth, and they doubtless did not practice effective dental hygiene. Labial and buccal accretions are common. Many teeth were lost early in life in this group, which condition is in contrast with the other tribes. With loss of one or more teeth from the arches there was subsequent migration in the arch of the adjoining teeth with consequent food impaction, which predisposed toward both caries and periodontoclasia. Thus a vicious cycle was continually kept up. No tooth in the series was immune to caries in the Zuni. The lower second molar was the most susceptible. The following table shows per cent of loss of the Zuni teeth, largely due to caries; there is one completely edentulous mandible:

Upper Teeth	per cent	Lower Teeth	per cent
Third molar	25	Third molar	27
Second molar	20	Second molar	21
First molar	15	First molar	24
Second premolar	8	Second premolar	8
First premolar	6	First premolar	4
Cuspid	1	Cuspid	1
Lateral incisor	4	Lateral incisor	3
Central incisor	6	Central incisor	7

VII

Periapical Lesions—In the sixty-six Kentucky crania there are one hundred fifty osseous lesions about the apices of teeth. It is plainly evident that pulp exposure is the infectious atrium for these periapical lesions. In two cases pulp exposure was produced through tooth fracture, either from some external force or through abuse of the teeth. One hundred forty-eight lesions resulted from pulp exposure through attrition. In marked contrast to this unusual condition there is not a single case of pulp exposure with resultant abscess produced by dental caries.

The dissolution of continuity of bone about the apices of teeth whose pulps have died is usually well defined and limited. A differential diagnosis between this sort of lesion and the breaking down or absorption of the alveolar crest and inner walls concerned in various phases of periodontoclasia, is easily made. The two classes of bone destruction rarely fuse except in senility in which the buccal alveolar plate is absorbed. The periapical osseous lesions may have been either chronic alveolar abscess with fistula, or the result of long continued low-grade infection, proliferation of the apical alveolo-dental periosteum, the so-called dental granuloma.

Six of the periapical lesions in the Kentucky crania were distinctly cystic in character. The wall of the cavity is cortical in contrast with the osteoporosis of the ordinary alveolar abscess; and the buccal covering may be attenuated to a thin parchment-like membrane which may be greatly bulged. This radicular dental cyst is a variant of alveolar abscess; it is produced by proliferation of the epithelial rests of Malassez in the alveolo-dental periosteum following infection.

Included in the above cases of periapical osteitis are two cases of involvement of the maxillary sinus contiguous with the right first molar. Forty-eight per cent of the Kentucky crania had periapical osseous lesions.

Sixteen per cent of the Sioux crania show alveolar abscesses, in all twenty-three lesions. Twenty-two of the periapical lesions were resultant from pulp exposure through attrition, and one from pulpal involvement by caries.

Alveolar abscesses occur in thirty-five per cent of the Arikara crania. There are one hundred twenty-one osseous lesions about the apices of their teeth with the following primary causes: Pulp exposure through attrition in eighty-five; pulp exposure through caries in thirty-one; pulp exposure through fracture, usually subsequent to extended attrition, in five. Five of these lesions penetrate the maxillary sinus. Two of these are contiguous with the second molar and one with the second premolar. A few of these lesions are cystic in character; one, about the roots of the mandibular first molar, is multilocular.

Fifty-two per cent of Zuni crania show chronic alveolar abscesses. Pulp exposure following caries occurred in one hundred four teeth with consequent periapical lesion; and attrition or abrasion caused forty-three exposures with abscesses following. Twenty-four of these abscesses were about lower anterior teeth, probably the result of some industrial habit.

VIII

Periodontoclasia is the breaking down of the supporting tissues of the teeth. The destruction of the walls of the alveoli only are observable in crania, and this lesion is properly termed *alveoloclasia*, which means an absorption or other forms of destruction of the walls of the alveolus. The old term pyorrhoea alveolaris is misleading and inadequate and is being deleted from dental nomenclature.

In the Kentucky skulls there are no cases of generalized periodontoclasia throughout the arch. Neither is there a single case of atrophy of the supporting tissues of the lower anterior teeth which is of fairly frequent occurrence in modern people. The lesions appear to be strictly localized and for the most part about the molars. The disease is most advanced about the third molars and decreases gradually about the second and first, with practically no involvement of the premolars. Upon scrutiny some local physical cause is usually apparent. Often there is a loss of contact between the second and third molars subsequent to advanced attrition; this condition predisposes to constant interstitial impaction of food which results in destruction not only of the soft tissue but of the septal bone. This is the greatest single factor in the causation of alveoloclasia in this group. Frequently there is marked absorption of bone in the retromolar fossa and generally about the lower third molars; this is doubtless resultant from chronic cellulitis of the redundant soft tissue about these molars. In the entire group, there are only about thirty teeth, mostly molars, involved in alveoloclasia.

In senile cases in addition to alveoloclasia, as just described, or periapical abscesses, there is a characteristic absorption of the buccal plate of the alveoli with extrusion first of the apices of the teeth, and eventually complete buccal plate absorption and gradual exfoliation in that direction of the teeth. This exfoliation is aided by advanced attrition, bringing the occlusal stress on unusual planes; however, some prefer to refer to this condition as physiological rather than pathological as it is an invariable accompaniment of generalized senile osseous atrophy.

With the Sioux, disease of the supporting dental tissues, like caries, is almost negligible, except in persons of advanced years. The preservation of well defined alveolar crests indicates these people were unusually free from periodontal disease. In the Sioux skull the first periodontal lesion apparent is an atrophy of the crest of the lingual alveolus of the upper molars. Absorption of bone about the lower third molar occurs quite frequently as with the former group. There were instances of the alveolar septa having been destroyed by food impaction following loss of contact.

Thirty-three per cent of the Arikara, as compared with thirteen per cent of the Sioux, evidence alveoloclasia. As in the other crania, periodontal disease is localized about the molars, the greatest number and most advanced lesions occurring about the third molars, with decreasing frequency about the second and first. There are no instances of alveoloclasia about incisors either upper or lower. Destruction of alveolar septa resulted from food impaction due to loss of contact. Alveolar atrophy most always accompanied general senility. Complete absorption of the buccal plate with eventual exfoliation of the teeth in many instances occurred.

Alveoloclasia is apparent in at least fifty-six per cent of the Zuni crania. Periodontal disease is not restricted in the Zuni to the molars, but all the teeth were susceptible, and in many skulls there is a generalized alveoloclasia. The crests of the alveoli apparently became ill defined fairly early in life; in fact, it is difficult to find a skull in which there is good definition of the septal crest. Thus periodontal disease was widely prevalent in the old Zuni.

IX

The following miscellaneous notes and descriptions of cases photographed pertain to the Kentucky tribe. There is one case of developmental hypoplasia of the enamel of the upper central incisors; it consists of a more or less generalized pitting of the enamel. No other instances of developmentally defective dental tissues were observed. There certainly is no evidence of congenital syphilitic stigmata of the teeth.

Small enamel nodules, about 1 mm. above the enamel margin, were observed on two left upper second molars and on an upper third molar. These little pearl-like neoplasms result from ameloblasts which have become detached from the enamel organ.

A fifth rudimentary cusp, buccal to the mesio-buccal cusp of the right second maxillary molar, was found in two instances; and a similar accessory cusp occurred in two instances on the left maxillary third molar. Atypical teeth in this group were rather rare. Three very small, and one diminutive, upper left third molars, and two small right upper third molars were observed. There is one atypical right mandibular second premolar.

Deposits of calculus about the teeth were comparatively rare, there being only nine cases with fairly large deposits, all about the molars. There is not a single case of salivary deposits on the lingual surfaces of the mandibular incisors; such deposits are very common in modern people. Most of the teeth of this Kentucky tribe are highly polished, possibly due entirely to extreme functioning on food which tended to leave the teeth clean. Personal cleansing, possibly with some fibrous material, of the buccal aspects may also have been practiced as the polish of the teeth generally is quite noticeable. There is no evidence of any form of dental operations, with the possible exception of some crude manner of removing third molars, with which a goodly portion of the surrounding process was knocked out.

For the detailed notes see Appendix.

Notes on the Sioux: There is developmental hypoplasia of the enamel of the lower incisors in a skull with a generalized chalky consistency of bone; this enamel hypoplasia is in the form of horizontal rows of pits. In an upper third molar of another case there is a similar horizontal row of pits, which probably resulted from nutritional disturbance during the developmental period.

Only one supernumerary tooth was observed in the tribe. This is a diminutive upper left fourth molar in position distal to the third, the latter was small. In the skull of a person about forty years of age at decease, there is a lower left second deciduous molar in a good state of preservation.

Two cases of atypical upper right lateral incisors were noted; these teeth had an extremely deep fissure running from mesial to distal, that is, the labial and lingual lobes of these teeth had largely failed to coalesce Caries did not localize in the deep fissure in either case. There is one instance of atypically shaped upper lateral incisor. An accessory mesiolingual cusp on an upper right second molar was noted. There is a case of suppression of the mandibular central incisors. With regard to aberrant size the following were noted: three small upper third molars, three diminutive upper third molars, three small lower third molars, one extra large lower third molar.

A sub-adult female Sioux has a very marked canine variety of denture. The crowns are unusually long, particularly the mandibular cuspids; and the upper anterior teeth greatly overlap the lower teeth. Thus the case differs decidedly from the frequent end-to-end bite. The most distinctive feature of this case, however, is a bilateral diastema distal to the mandibular cuspids. The upper second molars are rather small. These traits, particularly the diastemata, may be atavistic in tendency.

In the mandible of a female about fifty years of age at decease, there is extreme lingual inversion of the angle co-extensive with the area marked by the insertion of the ptyergoideus internus muscle. There is more widespread and advanced caries in the teeth of this mandible than in any Sioux specimen.

There is one case of mandibular prognathism, Class III (Angle) malocclusion. As a result of the lower anterior teeth occluding labially to the uppers, there is a marked labial attrition of the upper incisors. The labial alveolar plate of the lower anterior teeth is extremely attenuated. The upper third molars are diminutive; and the lower right first premolar is in linguo-occlusion.

More than sixty per cent of the Sioux crania showed no dental pathological lesions whatsoever. With the exception of the third molars, the teeth were retained until senility. Some of these teeth may have been knocked out because of acute cellulitis attendant upon eruption. The teeth were generally quite clean.

Detailed notes in appendix.

Notes on the Arikara: The following congenital defects of the enamel were noted. Four cases in which there is hypoplasia of the enamel of one or more teeth; and one case in which there is a more or less generalized pathological pigmentation of the enamel. The latter condition is comparable to what has recently been referred to as mottled enamel, its occurrence being restricted to endemic areas in the west. The upper lateral incisors in this case are peg-shaped.

In four cases there is one or more enamel nodules on the molars; and on many molars the enamel margin is not sharply marked, there being a tendency for the enamel to stream down the cervix to the bifurcation of the roots.

Supernumerary teeth were noted in the following positions: In two instances between the upper central incisors; one between the upper lateral and cuspid; and one between the upper second and third molars. Accessory cusps were noted on several molars, one instance of which is a case of bilateral sixth cusp on the lower third molars.

There is a case of suppression of the mandibular lateral incisors. In one skull an impacted upper cuspid lies in the horizontal plane with the crown impinging on the apices of the roots of the central and lateral incisors, with consequent extensive resorption. The etiology of this impaction is prolonged retention of the deciduous cuspid.

The following conspicuous bone lesions were observed in the Arikara: Opposite the apex of the lingual root of the upper first molar in an aged individual there is an area about 1.5 cm. in diameter on the palate marking the location of a severe chronic periostitis; a fistula connected this area with the apex of the lingual root.

In another case a large fistula runs from the apex of the lingual root of an upper molar, the pulp of which had been exposed through attrition, through the bone to an inward and forward position on the palate; surrounding the opening is evidence of considerable periostitis.

In one senile skull there is a smooth exostosis on the palate along the median suture. This is a benign overgrowth.

One skull shows a general lateral depression of the left maxilla; the upper left molars and bicuspids with supporting process are nearly 1 cm. lingual to the normal line of occlusion. This may have been an old fracture of the left maxilla.

In a female about forty years of age, there is evidence of extensive and severe arthritis of the right temporomandibular articulation. The glenoid fossa is flat and much roughened; the articular surface of the condyle is flat, rough, osteoporotic and apparently articulated with the eminentia articularis. The whole right ramus is thin and atrophied. The arthritis evidently produced partial unilateral ankylosis.

The uncleanliness of the teeth of the Arikara is exceeded only by that of the teeth of the Zuni. The character of the food tended to harbor debris, and there is no evidence of personal cleaning. Heavy buccal deposits occurred on the molars.

Among the Zuni crania, there are several cases of developmental tissue defects in the form of pathological pigmentation as well as hypoplasia of the enamel. An enemal nodule occurs on the lingual aspect at the bifurcation of the roots of a lower third molar.

A supernumerary tooth between the upper central incisors is present in two skulls. There are many instances of atypical upper lateral incisors.

There is marked uncleanliness of the teeth of the Zuni. Both salivary calculus and stains appear on most of the teeth. The evidence indicates there was no vigorous mastication of food with accompanying friction of tooth surfaces and healthful stimulation of the supporting tissues.

X. Summary

The present study shows conclusively the very marked effect upon pathology of the teeth of the mode of life and particularly the nature of the food in even closely related groups of people.

Morphologically, the feature of prominent marginal ridges and cingulum on the lingual aspect of the upper incisors, is common to all four tribes whose skulls were examined. The Kentucky tribe is characterized by teeth of large size, broad concavo-convex approximal surfaces of molars and bicuspids, and few atypical teeth; the denture of the Sioux is superb, the walls of the alveoli are thick with high well-defined crests; the teeth of the Arikara are somewhat similar to those of the Sioux; the teeth of the Zuni are smaller than those of the other tribes and have more developmental aberrations.

Generalized, advanced attrition, with many alveolar abscesses resultant, is the distinctive pathological feature of the prehistoric Kentucky tribe.

The Sioux are peculiarly free from dental and paradental lesions.

The teeth of the Arikara show marked attrition, with many alveolar abscesses resultant, caries occurred quite frequently, and alveoloclasia is evident about the molars.

Caries occurs in seventy-five per cent of Zuni crania, most caries had its initiation on exposed dentin or cementum cervically from the enamel margin, no tooth in the series was immune, many teeth were lost from caries; periapical abscesses occurs in fifty-two per cent of cases; alveoloclasia is almost universal about the molars.

REFERENCES

Hellman (Milo)—Food and Teeth. *Dent. Cosmos*, 1925, 185–195.

Hodge (F. W.)—Handbook of American Indians, 2 Vols. (Bureau of American Ethnology, Bull. 30), Washington, 1910.

Hrdlička (Ales)—Shovel-Shaped Teeth. *Am. J. Phys. Anthrop.*, 1920, III, 429–465.

————Anthropological Work in Peru in 1913, With Notes on the Pathology of the Ancient Peruvians. *Smith. Misc. Col.*, LXI, 18.

————Variation in the Dimensions of Lower Molars in Man and Anthropoid Apes. *Am. J. Phys. Anthrop.*, 1923, VI, 423–438; also: New Data on Teeth of Early Man and Fossil European Apes. *Ibid.*, 1924, VII, 109–132.

Leigh (R. W.)—Progress in Dental Hygiene. *Intern. Clinics*, 1924, III, 6–28.

Ruffer (Sir Marc Armand)—Abnormalities and Pathology of the Teeth of Ancient Egyptians. *Am. J. Phys. Anthrop.*, 1920, III, No. 3; also: Studies in the Palaeopathology of Egypt, 8°, Chicago, 1921.

Thoma (Kurt H)—Oral Diseases of Ancient Nations and Tribes. *J. Allied Dent. Soc.*, 1917, 327–334.

APPENDIX

KENTUCKY CRANIA

No. 290,057. This mandible shows bilateral impaction of the lower third molars. The left third molar lies horizontally with its root embedded in the ramus and the crown heavily impacted with the occlusal surface in contact with the cervix of the second molar. The right third molar is tipped mesially at a lesser angle than that of the left. There is also linguo-occlusion of the right lateral incisor. There is first degree attrition of the teeth; but no caries or other lesions. The labial exposure of the roots of the anterior teeth is due to post mortem alveolar fracture.

No. 290,076. K4. This photograph of the occlusal aspect of the maxillary teeth of a child about nine years of age is of much interest. The first premolars are not yet in occlusion, and their alveoli are not completed. The second molars were not erupted at decease but show the fully formed crowns in their respective crypts. Well pronounced marginal ridges of the incisors produce a roughly triangular deep concave central fossa on the ligual aspect. This striking morphological feature of the upper incisors is a distinguishing characteristic of the American Indians, and has been thoroughly and extensively studied by Hrdlicka. The first molars, although having been in occlusion only about three years, show well defined first degree attrition; and the second deciduous molars yet in situ evidence third degree attrition. Other than this physiological wear in the masication of food, there are no lesions in or about the teeth.

No. 290,015. K5, K6. This case shows second to third degree attrition of all the upper teeth. The pulps, particularly of the first molars, have been able to protect themselves by the formation of secondary dentin in the line of their recession from the wearing surfaces. There has been a fracture of the mesio-lingual portion of the left first premolar. This fracture exposed the pulp with its subsequent death and development of a fairly large periapical alveolar abscess. Fracture of the teeth is one of the sequences of attrition, but in this case there may have been some traumatic force or abuse of the teeth which produced the fracture. There is no caries and through extreme use the teeth were kept highly polished.

No. 290,018. K7. This case shows the following pathological conditions: dental caries, periodontoclasia, fracture with pulpal exposure and resultant periapical osteitis, fourth degree attrition involving pulp with resultant periapical abscess. The caries is located on the distal surface of the left second molar at the cervix in the exposed dentin subsquent to gum recession. Caries is localized more often in this area than any other in the teeth of these people. There is much evidence of chronic periodontitis including marked alveoloclasia about the left cuspid and first premolar. Other areas of root exposure are due to post mortem alveolar fracture. The upper right cuspid was fractured on its mesial aspect which resulted in pulpal death with periapical osseous lesion. The teeth show well advanced attrition on an obtuse plane directed toward the linguo-cervical margin; this manner of wear is characteristic of the upper teeth. The attrition was so rapid that the pulp of the right first molar was unable to protect itself by the formation of secondary dentin and resulted in death of the pulp with extensive osseous lesion about both buccal and lingual roots, the photograph showing only the periapical lingual root lesion.

No. 290,020. K8, K9. This is a typical senile case, the age of the subject probably being about seventy years or more at decease. All of the teeth show third to fourth degree attrition. The pulps of the left second premolar and first molar were exposed through attrition with resultant death and periapical bone involvement. The pulps of the right cuspid, first premolar, second premolar and first molar were all exposed through attrition with resultant death and periapical osseous lesions. A cavity 1 cm. in diameter is located about the apices of the right cuspid and first premolar. It will also be noted that there is a buccal protrusion of the greatly worn teeth. The plane of wear eventually is transferred toward the buccal aspect and the forces thus applied tend to tip the apices of the teeth buccally, the buccal plate becomes entirely resorbed and the teeth eventually exfoliated in that direction. This atrophy of the alveoli and buccal exfoliation of the teeth is characteristic of generalized senile atrophy. Advanced wear of the teeth destroys the proximal contact which produces an open diastema between the teeth and this affords interstitial impaction of food with

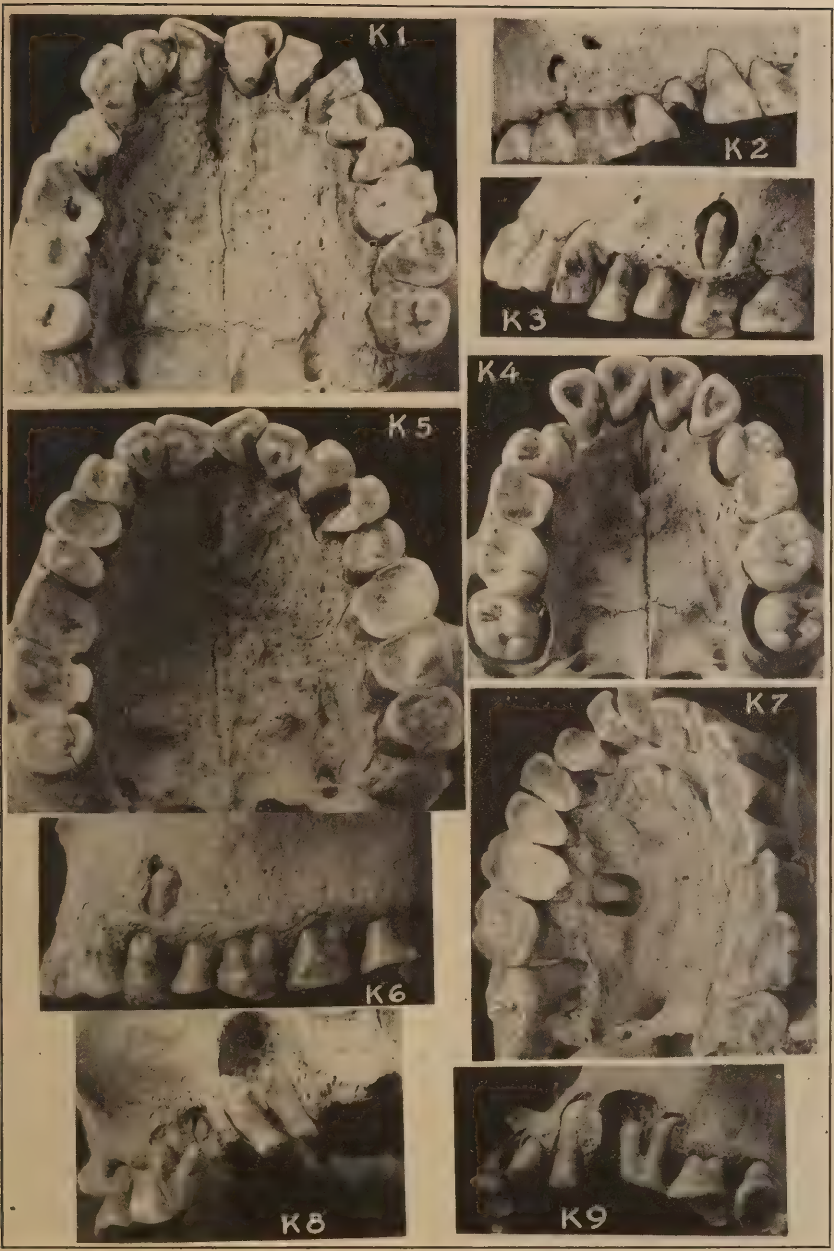

PLATE I.—K1. Attrition, exposure of pulps both M_1. K2. Periapical abscess above r. of preceding. K3. Alveolar abscess about l. of preceding. K4. Child: Pm_1 not in occlusion, Dec.M_2, third degree attrition; M_1 first degree attrition. K5. Advanced attrition, fracture left Pm_1. K6. Alveolar abscess preceding left Pm_1. K7. Attrition, exposure of pulp right M_1, periapical abscess. K8. Senile exfoliation, alveolar abscess. K9. Senile exfoliation.

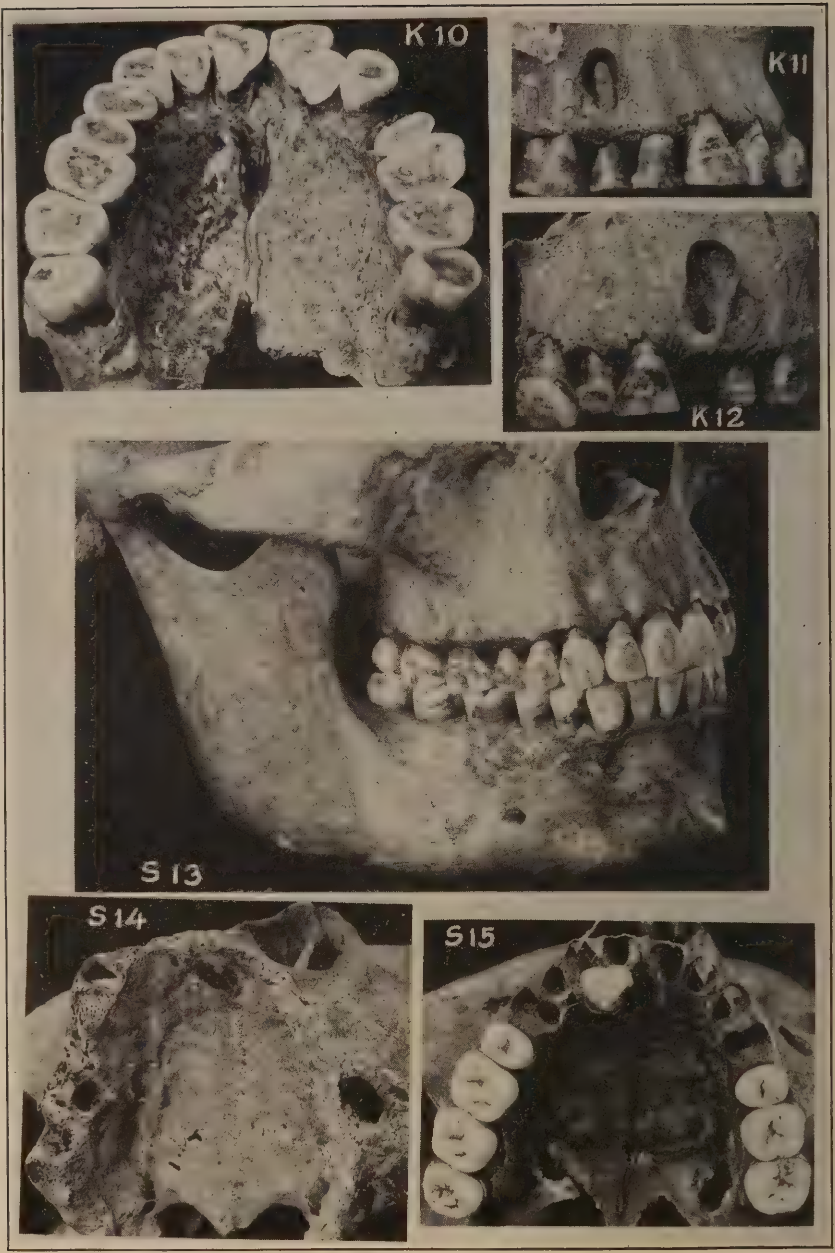

PLATE II.—K10. Third and fourth degree attrition, exposure of pulps of r. Pm_2 and l. Pm_1. K11. Periapical abscess preceding r. Pm_2. K12. Radicular dental cyst about alveolus preceding l. Pm_1. S13. Normal occlusion, edge-to-edge relationship of incisors. S14. Fistula l. maxillary sinus, periostitis l. maxilla. S15. Impacted upper r. cuspid, prolonged retention of deciduous cuspid.

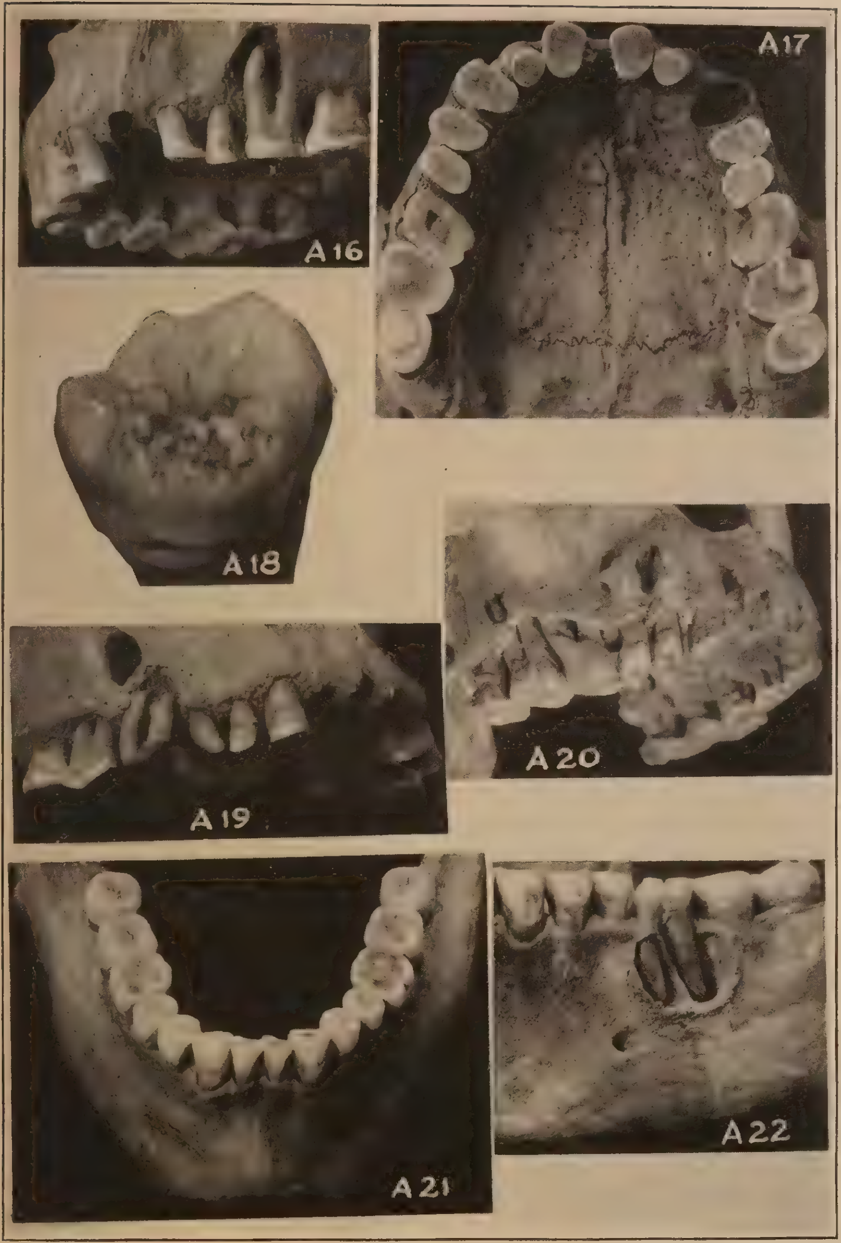

Plate III.—A16. Attrition, alveolar abscess l. M_1. A17. Third and fourth degree attrition exposure of pulps l. and r. M_1 of preceding, l. cuspid lost post mortem. A18. Upper M_2, developmental enamel hypoplasia, caries. A19. Senile, old alveolar abscess, alveoloclasia. A20. Alveoloclasia, deposits, exposure of pulps of Pm's through attrition, resultant abscesses. A21. Suppression of mandibular I_2. A22. Multilocular cyst about M_1 resultant from caries.

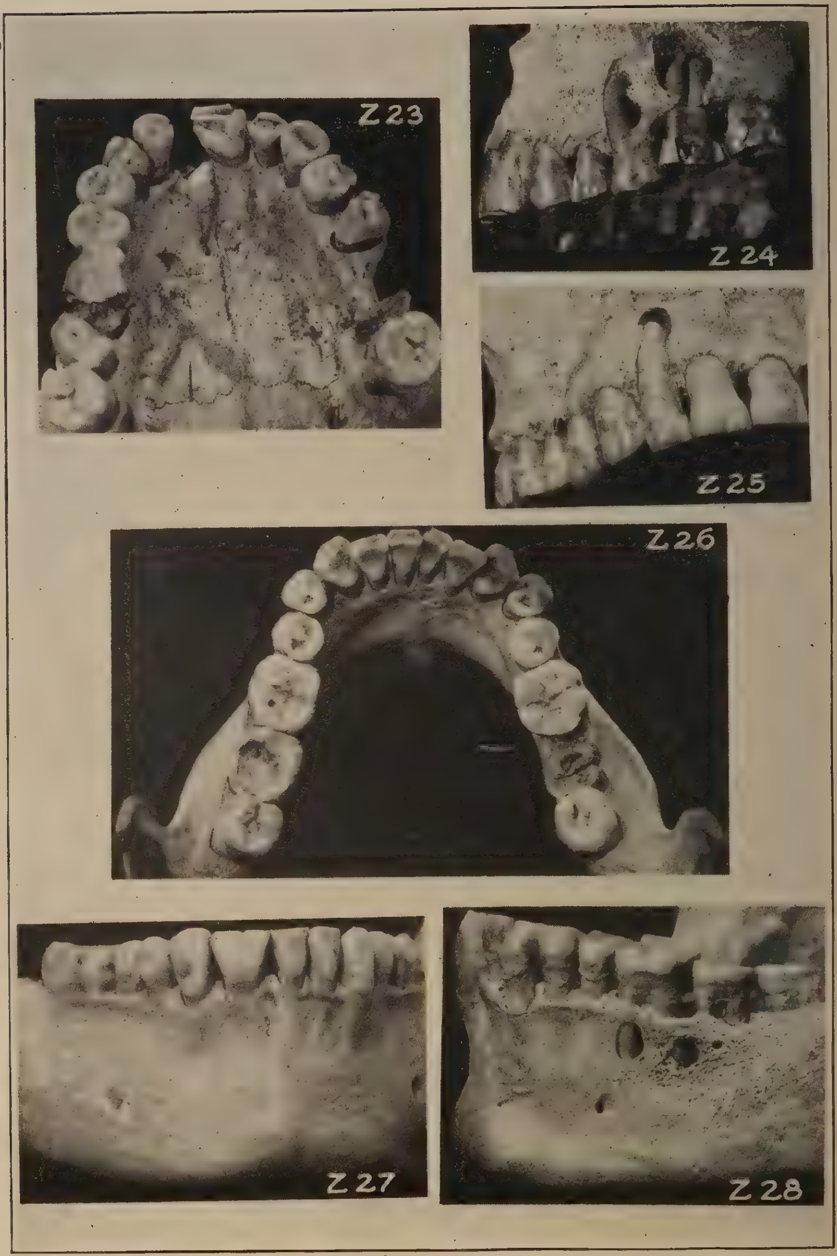

PLATE IV.—Z23. Caries, M_1 lost, non-erupted atypical tooth with fistula. Z24. Alveolar abscesses above molars. Z25. Periapical abscess. Z26. Advanced caries of M's$_2$, deposits. Z27. Gemination. Z28. Alveolar abscesses, interproximal dental caries, deposits.

resultant atrophy of the alveolar septa. This latter condition is well marked between the upper left second and third molars.

No. 290,063. K1. The photograph of the occlusal aspect shows bilateral pulpal exposure of the first molars. The aperture in the left molar exposed only the cornu of the pulp, while the entire roof of the pulp chamber was worn away in the right molar. There are no other lesions in these teeth; but considerable post mortem fracture is evident.

K2. Photograph of the right buccal aspect shows the osteoporotic dissolution about the apices of the roots of the right first molar. There may or may not have been a fistula through the soft tissue.

K3. Photograph of the left buccal aspect shows an extensive lesion around the entire mesio-buccal root of the left first molar with well defined margin and also an osteoporosis about the disto-buccal root. There is also a similar lesion about the lingual root. These osseous lesions about the apices of the roots of teeth whose pulps have died, no matter what the cause, are fairly typical. There is also an absorption of the crest of the buccal and septal walls of the alveoli.

No. 290,082. K10. Photograph of the occlusal aspect shows generalized second to third degree attrition of all the teeth. Secondary dentin has filled in the space formerly occupied by the cornua of the pulps, but in the case of the right second premolar the recessional line of the buccal cornu has been exposed with subsequent pulpal death. The left first premolar has been lost post mortem, but the neighboring and occulding teeth conclusively prove that it must have been equally worn, and a large osseous lesion about its alveolus quite conclusively shows that it suffered pulpal exposure through attrition. There is pronounced linguo-occlusion of the left lateral incisor. A definitely developed carious cavity is located in the occlusal surface of the right third molar. The mandible of this case presented no dental lesion other than attrition.

K11. Photograph of the right buccal aspect shows a fairly large osseous destruction about the apex of the right second premolar whose pulp was exposed.

K12. Photograph of left buccal aspect shows a well defined radicular dental cyst about the alveolus of the left first premolar. The wall of this cavity is cortical in character, rather than osteoporotic as obtains in the usual periapical lesion, and the buccal margin shows that considerable buccal protrusion had existed with a very thin parchment-like covering of bone before decease. The pathogenesis of these radicular cysts is the proliferation of epithelial rests in the alveolo-dental periosteum followed by central cystic degeneration; this disturbance is consequent upon infection via the apical foramen. Accumulation of fluid in the cyst gradually increases with destruction of the surrounding bone.

Sioux

No. 243,702. Pronounced absorption in both retromolar fossae is evident. On the right side the dissolution of bone extends around the distal and buccal aspects of the third molar, exposing the roots of this tooth. The cause of this condition was probably inflammation of redundant soft tissue about the lower third molars.

No. 243,378. S14. This senile case shows an almost edentulous maxilla, there having been present at decease only the upper right cuspid, lingual root of first molar, and second molar. The alveolar process of the left maxilla is completely resorbed; and the buccal aspect shows a generalized reduction of that bone. The atrophied left side is in contrast to the right in which the alveolar process largely remains. An aperture 1 cm. in diameter which was contiguous with the apex of the first molar leads into the maxillary sinus. This aperture no doubt was a fistula draining a purulent maxillary sinus of very old standing, and the affection spread to a general osteitis of the left maxilla.

The mandible of this case showed advanced senility. It was completely edentulous, and the alveolar process had been absorbed to the extent that the mental foramina were on the superior border; and the right mandibular canal was exposed through absorption.

No. 243,723. Most of the teeth from this skull had been lost post mortem. The upper left first molar was worn into the pulp, with resultant periapical abscesses about both the lingual and buccal roots, which are not shown in this view. The right first molar was lost post mortem but the evidence is that it had suffered an equal degree of attrition, and the dissolution of continuity of bone about the apices of its alveoli is extensive. Above the alveolus of the lingual root there is a porosity of bone which perforates the nasal floor.

No. 243,360. S15. This maxilla shows loss of upper left third molar prior to decease, the alveolar process about this tooth is completely gone and inasmuch as there are no other acquired lesions either in the upper or lower teeth it may have been that this tooth was intentionally removed by some form of crude extraction. The anterior teeth, including a retained right deciduous cuspid, have been lost post mortem, except the right cuspid which is impacted. The tip of this cuspid may have shown through the mucous membrane. The prolonged retention of the deciduous cuspid was certainly the cause of abnormal position and non-eruption of the permanent cuspid, whose crown is deflected mesially, lingually and toward the horizontal plane. There is dilaceration of its apex which has an extremely thin covering of bone buccally.

No. 243,375. S13. This photograph shows a skull in which there is the full complement of thirty-two teeth. The occlusion shows normal mesio-distal relationship of the upper and lower arches as determined by the relationship of the upper and lower first molars. It will be noted that the upper central incisors do not overlap the lower incisors but occlude on the incisal edges. This is known as an edge-to-edge bite. This example of occlusion is not only normal but is characteristic of the American Indian; and it has been observed and described particularly by Milo Hellman. This was a male subject of about thirty-five years of age at decease and the cusps of the teeth were slightly worn. There is a small carious pit in the occlusal surface of each of the lower third molars. The deposits on the buccal surfaces would indicate no artificial method of cleaning the teeth was in vogue.

No. 243,725. Upper right lateral incisor in which there is a deep developmental fissure reaching to the cervix, the labial and lingual lobes failed to coalesce. Caries did not develop in this defect.

ARIKARA

No. 325,404. A18. Developmental hypoplasia of enamel of an upper right second molar. This poorly formed tissue has proven susceptible to caries which localized on the occlusal surface and advanced to the pulp.

No. 325,417. A21. Suppression of the mandibular lateral incisors.

No. 228,880. A20. Alveoloclasia involving the molars and to a less extent the premolars. Periapical absesses above the premolars consequent upon pulp exposure through attrition. Heavy salivary deposits on teeth may have a causative relation with the periodontoclasia.

No. 315,539. A22. There is a radicular multiocular cyst about the roots of the lower left first molar. The radicular cyst is a variant of the alveolar abscess. The primary cause in this case is pulpal necrosis following caries of the hard parts.

No. 325,424. A19. In the right maxilla is an old abscess presenting large aperture buccally with well-rounded margin; this lesion is contiguous with apex of first molar, the pulp of which had been exposed through attrition. The other teeth show advanced attrition; anterior teeth lost post mortem.

No. 325,350. A17. Occlusal aspect of upper teeth all of which show advanced attrition. Exposure of both first molar pulps has been brought about by wear. Left cuspid has been lost post mortem.

No. 325,350. A16. Left buccal aspect of the preceding. The teeth shortened by attrition are shown in profile. Typical periapical abscess about the mesial root of the first molar, the pulpal exposure of this tooth is shown in the preceding photograph.

ZUNI

No. 308,650. Z23. Occlusal aspect of upper teeth. This is a good representation of widespread and advanced caries so common in the Zuni teeth. There is an occlusal and also bucco-cervical lesion in left third molar; the crown of the second molar has been largely destroyed by caries; the first molar had been lost for some time prior to decease, and in all probability this loss was the result of caries; the left first premolar is carious at the cervix; the right central incisor was lost some time before decease, and near the location of the lost central is a non-erupted anomalous supernumerary tooth with two roots: one assumes a labial position, it has a dilacerated apex, ending in a sharp curve labially and downward; the other root is in a horizontal plane in the palate, and its apex is surrounded by a cystic cavity 1 cm. in diameter which encroaches on the lateral incisor and cuspid, and communicates with the palatal surface through a fistula. Caries has localized in the lingual pit of the right lateral incisor. The photograph shows an extensive carious lesion on the distal approximating surface of the right first molar the pulp of which is involved. Facing this last cavity is a large lesion on the mesial surface of the second molar, the pulp of this tooth also was involved by the caries. There is a carious pit on the occlusal of the right third molar.

No. 308,410. Z24. Left buccal aspect shows periapical abscesses about the first and second molars, the pulps of which have been infected through caries.

No. 308,641. Z27. Complete gemination of mandibular right central and lateral incisors has occurred.

No. 308,617. Z25. There is a periapical abscess above the right lateral incisor. There is no lesion in the crown of this tooth exposing the pulp.

No. 308,647. Z26. Occlusal aspect of mandibular teeth shows extensive destruction of crown of both second molars. Occlusal in addition to buccal deposits evidence lack of function of the teeth and no cleaning.

No. 308,620. Z28. The left buccal aspect of mandible shows caries on the approximal surfaces of the first and second molars which has destroyed contact, invariably following which is food impaction, produced necrosis of the pulp with periapical infection and abscesses. Buccal deposits are present; and the crests of the alveoli have been absorbed.

WEIGHT OF THE BRAIN AND OF THE INTERNAL ORGANS IN AMERICAN MONKEYS

WITH DATA ON BRAIN WEIGHT IN OTHER APES

A. HRDLIČKA

In the early part of 1924 Mr. John L. Baer, at that time my temporary assistant, left for the Isthmus of Darien to look into the question of the "White Indians" (who have since proved to be albinos), and also at my suggestion to gather as many data as possible on the proportions of the internal organs in the monkeys of that region.

Mr. Baer was an earnest and painstaking worker, and notwithstanding the many local difficulties and his subsequent illness, he gathered observations on a good series of Indians (to be published later), and also in a fair series of Howler and "Squirrel" monkeys which were hunted by him or the Indians for this purpose. Unfortunately in skinning the animals he was repeatedly bitten by a species of fly and the resulting sores after having almost healed became infected through wading, septicaemia set in, and Mr. Baer succumbed before help could be reached. But the data he secured were preserved and brought back by Mr. Richard O. Marsh who organized the expedition. We have reduced the English weights to metric, calculated the proportions of the different organs to the weight of the body, and the resulting data are here given. Though limited they are possibly the most complete records of this nature ever secured and will be of utility.

Mr. Baer's records were accompanied by a few notes which are here reproduced, together with those concerning his illness:

ABSTRACTED FROM MR. BAER'S DIARY: *Monkeys: Thursday, Feb. 21, 1924:* Arrival at Avelino's house up Rio Chico. Bought squirrel monkey from boy. Measured and weighed but organs were too far gone to save.

Wednesday, March 5: One black howler (No. 1).

Thursday, March 6: Saved skin and skeleton of Howler No. 1. Weighed organs. Made plans for trip to Canglou for monkeys.

Saturday, March 8: Shot two monkeys; made camp at mouth of Canglou and hung monkeys on tree after cutting and preserving parasites from neck of Howler.

Sunday, March 9: Dissected monkeys No. 2 and 3 and skinned No. 3 and saved skeleton.

Monday March, 10: Helped Indians skin monkeys.

Tuesday, March 11: Dissected and weighed organs of three monkeys.

Monday, March 24: Packed skins and organs of monkeys.

Sunday, March 30: On trip up Chucanaque River. M. and R. each shot a Howler. Saw white faced monkey along shore. Skinned No. 7 and dissected and weighed organs of No. 8 which was too badly shot up to save skin. Hind leg nearly shot off, holes through body and head. Although much loss of blood and stomach contents, weight 15½ lbs.

Friday, April 11: Negroes brought in two squirrel monkeys which I preserved in alcohol after measuring and weighing organs.

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	HOWLER MONKEYS: MEASUREMENTS (*Alouatta pulliata inconsonans*)							"SQUIRREL" MONKEYS (*Oedipómidas geoffroyi*)					
	No. 1	No. 2	No. 3	No. 4	No. 6	No. 7	No. 8	No. 5	No. 11	No. 13	No. 14	No. 12	No. 15
Sex	Male	Male	Male	Male	Male	Male	Male	Female	Male	Male	Male	Female	Female
Point of nose to tip of tail....	115 cm.	120 cm.	117 cm.	116 cm.	118 cm.	—	—	111 cm.	64 cm.	(Tail cut off)	63 cm.	63 cm.	65 cm.
Heels to point of nose......	82.–	83.5	83.–	82.5	83.–	—	—	79.–	36	35.5	35	36.5	37
Hips to point of nose......	53.–	54.5	53.5	53.–	53.5	—	—	52.–	24.5	25	25	24	26
Maximum finger reach.......	86.5	89.–	88.–	87.–	89.–	—	—	84.–	33	32	32	32.5	34
	grams	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*
Weight of body	6,917	7,824.5	7,257.5	7,031	7,484	7,257.5	7,031	5,670	510	482	510	453	567
Weight of brain	63.78	65.53	60.22	54.90	56.70	56.70	53.13	44.28	10.62	12.39	12.39	8.85	12.39
Ratio of body weight[1]......	*9.22*	*8.37*	*8.30*	*7.81*	*7.58*	*7.81*	*7.56*	*7.81*	*20.8*	*25.7*	*24.3*	*19.5*	*21.8*
Weight of heart.	23.01	24.78	26.55	19.47	23.01	19.47	23.01	17.70	3.54	3.54	3.54	3.54	3.54
Ratio of body weight......	*3.33*	*3.17*	*3.36*	*2.77*	*3.07*	*2.68*	*3.27*	*3.12*	*6.94*	*7.34*	*6.94*	*7.80*	*6.24*
Weight of lungs.	35.43	47.81	53.12	49.59	46.05	51.36	53.13	38.97	5.31	5.31	3.54	3.54	3.54
Ratio of body weight......	*5.12*	*6.11*	*7.32*	*7.05*	*6.15*	*7.08*	*7.56*	*6.87*	*10.41*	*11.02*	*6.94*	*7.80*	*6.24*
Weight of liver and gall....	258.60	256.83	234.42	248.04	242.73	223.23	232.11	205.53	26.55	21.24	19.47	24.78	21.24
Ratio of body weight......	*37.38*	*32.82*	*32.30*	*35.28*	*32.43*	*30.76*	*33.01*	*36.25*	*52.03*	*44.07*	*38.15*	*54.63*	*37.46*
Weight of spleen	35.43	35.43	35.43	44.28	37.20	30.12	42.51	33.60	1.77	1.77	1.77	—	2.65
Ratio of body weight......	*5.12*	*4.53*	*4.88*	*6.39*	*4.97*	*4.15*	*6.05*	*5.93*	*3.47*	*3.67*	*3.47*		*4.67*
Weight of kidneys.....	35.43	49.58	40.74	38.97	33.66	35.43	37.20	35.43	3.54	3.54	2.65	3.54	3.54
Ratio of body weight......	*5.12*	*6.34*	*5.61*	*5.54*	*4.5*	*4.88*	*5.29*	*6.25*	*6.94*	*7.35*	*5.19*	*7.80*	*6.24*
Weight of testes or ovaries....	30.11	28.35	26.55	21.28	24.78	19.47	24.78	1.77	1.77	0.89	1.77	?	?
Ratio of body weight......	*4.35*	*3.62*	*3.66*	*3.03*	*3.31*	*2.68*	*3.52*	*0.31*	*3.47*	*1.85*	*3.47*		

[1] All ratios = per 1,000.

Saturday, April 12: J. brought in two squirrel monkeys which I skinned, opened and weighed organs.

His sickness: Sunday, March 9: Big flies about monkeys bite like H.

Sunday, March 16: Fly bites commenced to fester and are very painful. Using sulphur ointment.

Friday, March 21: Fly bites are getting worse.

Saturday, March 22: Sores very painful; bathed them with bi-chloride.

Sunday, March 23: Sores are responding to treatment but new ones continue to come. Commenced eating flowers of sulphur instead of applying it to sores.

Tuesday, March 25: Sores seem better except one under knee.

Wednesday, March 26: Sores improving rapidly. Dosed myself and others with sulphur, sodium phosphate, pills etc.

Sunday, March 30: I am feeling better...sweat nearly all night.

Tuesday, April 1: Sweat before and after watch.

Tuesday, April 8: Stayed in camp to doctor up infected bites which have gotten worse with so much wading. One on my right heel very deep. Two bad places on left leg ache like boils. Sand flies eat us alive. Mosquitoes not so bad.

Saturday April 12: Infected bites very sore.

A few days afterwards Mr. Baer died, apparently of septicaemia.)

Brain Weights in Other Apes

In 1905 the writer published a series of original observations of "Brain Weights in Vertebrates"[1] which included a number of records on the brains of monkeys. Since then a considerably larger number of such records has accumulated and it may be of use to other students to make them known. They are not yet ample enough in any case for definite conclusions, but present interesting indications, an abstract of which, on the adults in good condition, follows. The detailed data and records on the young are given at the end of this paper

REMARKS

The data here given offer mere indications of conditions. They have the great disadvantage of, first, extending to too few adults; and second, of dealing mainly with zoological-park material, which means bodies often, if not generally, in a more or less abnormal condition. What is needed is more ample records on wild forms such as those secured by Mr. Baer.

RECORDS ON ANTHROPOID APES

Of particular importance in this connection would be data on the anthropoid apes in the wild state. Regrettably there is but little that is satisfactory in this direction. Nevertheless there are records that give us something of value. They are the records on the priceless orang and gibbon material secured for the U. S. National Museum by Dr. W. L. Abbott. But while the apes were weighed on the spot after being killed, the brains were weighed only about six months afterwards upon receipt in the laboratory after they had lost perhaps as much as

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[1] *Smithson. Misc. Coll's,* XLVIII, 89–112; with Bibliography.

ABSTRACT OF BRAIN WEIGHT TO BODY WEIGHT RATIOS IN ADULT APES WHERE CONDITION OF BODY WAS NOTED AS MEDIUM

Adults: Males

Body-Brain Ratios[1]	10–20	20.1–30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	90.1–100	100.1–110	111 and above
Hylobates ag.				44.5							
Hylobates ag.				44.9							
Presbytis ferrug.								85.6			
Presbytis ferrug.								86.3			
Presbytis ferrug.								79.6			
Presbytis ?											115.2
Presbytis chrysom.									95.1		
Cercopithecus call.					51.–						
Cercopithecus call.					50.5						
Cercopithecus ceph.			33.3								
Cercocebus ful.			32.4								
Cercocebus ful.			35.7								
Papio dog.		27.4									
Papio anub.			32.–								
Papio sphinx		27.3									
Papio ham.								84.6			
Papio bab.					58.7						
Papio ?										104.4	
Macaque rhes.		20.4									
Macaque rhes.			30.2								
Macaque rhes.			34.9								
Macaque fasc.						61.8					
Macaque sin.				44.1							
Ateles geoff		20.2									
Ateles geoff.		27.6									
Ateles geoff		20.1									
Ateles geoff.		22.7									
Mycetus sen.					62.3						
Cebus hypol.	11.7										
Cebus hypol.	11.3										
Cebus hypol.	13.6										
Cebus hypol.	16.9										
Cebus hypol.	16.6										
Cebus hypol.	14.1										
Marmoset		27.8									
Marmoset		24.2									
Callithrix jaech.	13.7										
Lemur varius									97.8		
Lemur macaco									99.5		
Lemur macaco							74.5				

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[1] $\frac{\text{Weight of body}}{\text{Weight of Brain}}$.

Adults: Females

Body-Brain Ratios	10–20	20.1 30	30.1–40	40.1–50	50.1–60	60.1–70	70.1–80	80.1–90	90.1–100	100.1–110	above 110
Presbytis ferrug.									97.4		
Presbytis ferrug.									99.9		
Presbytis ferrug.									96.1		
Presbytis rubic.										109.1	
Papio bab.			33.6								
Papio obs.					59.3						
Papio dog.			33.8								
Cynopithecus nig.			35.4								
Macacus rhe.			38.2								
Ateles geoff.		24.–									
Mycetus sen.						61.9					
Cebus hypol.	19.2										
Cebus hypol.		27.9									
Cebus hypol.		24.3									
Marmoset		28.1									
Marmoset		23.8									
Marmoset oedipus			36.5								
Marmoset oedipus			32.9								
Lemur var.								85.–			
Lemur var.						68.–					

one-sixth of their weight in the preservative (about 10 per cent formalin solution).[1] In only two cases was the brain also weighed in the field; but in three additional ones the brain was left in the skull which was placed in the preservative, and in these the organ appears not to have lost in weight but may even have gained a little. In addition to the Abbott material there are also the weights of two adult male chimpanzee and six adult female gorilla brains taken on specimens secured in the Cameroons. In these cases the brain also lay for a good many months in a preservative, the exact composition of which is not known. If the records on all this material are nevertheless given here it is only to show the approximate values, the individual variation, and especially the sex differences, which probably have not been substantially affected.

SEX DIFFERENCES IN BRAIN WEIGHT

In the human subject the female to the male brain in weight (as well as volume) averages about as 90 to 100, the exact ratio differing somewhat in every series. The following abstract from the foregoing and former records shows that conditions in the anthropoid apes are fairly similar, though the exact relation of brain weight in the two sexes differs more or less from species to species. These differences are doubtless connected essentially, if not wholly, with the relative difference of

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[1] See author's "Brain and Brain Preservatives," *Proc. U. S. Nat. Mus.*, 1906, XXX, 5–320.

Brain Weight in Adult Anthropoids

	Males		Females	
	Body Weight grams	Brain Weight grams	Body Weight grams	Brain Weight grams
CHIMPANZEE (Cameroon)...	—	341[1]		
CHIMPANZEE (Cameroon)...	—	402[1]		
GORILLA (Cameroon)........			—	345
GORILLA (Cameroon)........			—	350
GORILLA (Cameroon)........			—	357
GORILLA (Cameroon)........			—	405
GORILLA (Cameroon)........			—	407
GORILLA (Cameroon)........			—	411
ORANG....................	72,575	326	34,474	267[2]
ORANG....................	49,895	347.5	36,287	274.5
ORANG....................	86,183	359	35,834	279
ORANG....................	63,503	368	36,288	283
ORANG....................	54,431	371	44,452	287.5
ORANG....................	83,915	384	34,019	291
ORANG....................	90,720	395	36,741	304
ORANG....................	79,379	422	32,659	322
ORANG....................			32,659	326
ORANG....................			39,917	340.5
ORANG....................			37,195	344
SIAMANG..................	12,744	133[2]	11,793	128[2]
SIAMANG..................			12,701	139.5
GIBBON				
Hylobates agil.............	4,309	96.9[3]		
Hylobates agil.............	4,879	108.7[3]		
Hylobates sp...............	5,897	106.5[4]	6,240	99[4]
Hylobates sp...............			6,240	99.5[4]
Hylobates agil.............	5,443	79.2[2]	5,333	76.–[2]
Hylobates agil.............	5,670	81.5	4,536	77.–
Hylobates agil.............	4,989	83.–	5,670	86.5
Hylobates agil.............	7,372	87.5		
Hylobates agil.............	6,350	89.–		
Hylobates agil.............	5,897	93.–		
Hylobates agil.............	5,897	98.9		
Hylobates mull.............	4,876	84.4[2]	6,011	85[2]
Hylobates mull.............	5,443	108.5	6,804	91
Hylobates mull.............	6,228	97.4	6,123	95
Hylobates mull.............			6,454	99.4

[1] Weighed after many months in preservative.
[2] All weighed about 6 months after laying in preservative (10% formalin).
[3] True weight, in field.
[4] Brain left in skull, extracted and weighed in Laboratory, probably near true weight.

the sexes in size and mass of the body. Our data are preceded by records on skull capacities:[1]

Cranial Capacities in the Two Sexes in Anthropoid and Other Apes (Wild)

	Male	Female	Female: Male Brain (M = 100)
Chimpanzees[2]......................	350–470	350–440	95
Gorillas..........................	420–623	370–580	85
Orangs[2]..........................	355–575	300–490	90
Gibbons..........................	(81–120)		98[3]
Siamangs.........................	100–150	105–152	98[3]
Baboons..........................	120–200	120–160	83

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[1] Hrdlička (A.)—Anatomical Observations on a Collection of Orang Skulls from Western Borneo, with Bibliography. *Proc. U. S. Nat. Mus.*, 1906, XXXI, 539–568. The data on orangs include especially the valuable Selenka records.

[2] Oppenheim (St.)—Zur Typologie der Primatencraniums. *Z. Morph. & Anthrop.*, 1911, XIV, 1 *et seq.* See also: Martin (R.)—Lehrb. d. Anthrop., 653, 652.

[3] Need of revision and further observations.

DETAILS

The rest of the data, given in the following pages, must for the present be given merely as so much material, from which it is possible to draw but few conclusions. What is plain is that both the absolute and relative size of the brain differs considerably among the primates, and thus far there appears little regularity or law in these differences. Nevertheless the records on the young as well as the adults offer interesting indications. An interesting side-light is also that shown by the relative body weight in the two sexes of the various forms included. The disproportion in this respect in the orangs, where the adult males are practically twice as heavy as the females, is particularly striking, while in some of the gibbons and lower apes it is the female who is more or less heavier.

ABSTRACT OF U. S. NATIONAL MUSEUM RECORDS ON BRAIN WEIGHT IN WILD APES AND MONKEYS

BRAIN: BODY RATIO. SEX DIFFERENCES.

(Adult Forms, Body Medium)

	Body Weight (M. =100)	Actual Brain Weight (M. =100)	Ratio of Brain Wt. to Body Wt.	
			Males	Females
Anthropoids:			(8)	(12)
ORANGS (Wild)	50.2	80.7	Body Wt. 72,575 gm.	36,439 gm.
			Brain Wt.[1] 371.6	299.8
			Ratio: *195.3*	*121.5*
			(3)	(2)
GIBBONS (Wild) Hylobates	124.1	95.4	Body Wt. 5,028 gm.	6,240 gm.
			Brain Wt. (actual) 104.–	99.25
			Ratio: *48.3*	*62.9*
			(7)	(3)
Hylobates agil.	87.1	91.3	Body Wt. 5,946	5,180
			Brain Wt.[1] 87.45	79.8
			Ratio: (*68.–*)	(*64.9*)
			(3)	(4)
Hylobates mulleri	115.1	95.7	Body Wt. 5,516	6,348
			Brain Wt.[1] 96.8	92.6
			Ratio: (*56.8*)	(*68.6*)
Catarrhines:				
PRESBYTIS ferrug. (Wild)	100	85.3	1:83.8	1:97.8
PAPIO dog.	109.1	88.5	27.4	33.8
			(2)	(2)
MACACUS rhes.	101.5	83.2	25.3	36.5
Platyrrhines: (Baer's records)			(2)	(2)
OEDIPOMIDAS geoff. (Wild)	101.8	90.–	42.4	48.–

[1] Formalin solution, probably 10 per cent.

DETAILED DATA ON FRESH BRAIN WEIGHTS IN APES

Catalogue Number	Age[1]	Species	Locality	State of Body[2]	Length of Body	Weight of body	Weight of Brain	Brain Wt. per 1000 Body Wt.[3]	Ratio of Brain Wt. to Body Wt.[4]
ANTHROPOPITHECUS (CHIMPANZEE)									
Male:					*cm.*	*grams*	*grams*		
225,776	Young	troglodytes	N. Y. Zoo	M[5]	—	5,415	337.5	*62.3*	*1:16.–*
CERCOPITHECUS (GREEN AND MOUSTACHE MONKEYS)									
Male:									
228,290	Young	callitrichus	?	M	—	1,314	60.1	*45.7*	*21.9*
225,937	Adult	callitrichus	Nat. Zool. Pk.	M	—	4,082	80.–	*19.6*	*51.–*
228,080	Adult	callitrichus	Nat. Zool. Pk.	M	—	3,630	71.9	*19.8*	*50.5*
225,853	Adult	cephus	Nat. Zool. Pk.	E[6]	—	1,915	57.5	*30.–*	*33.3*
Female:									
228,178	Near Adult	callitrichus	Nat. Zool. Pk.	E	—	3,062	59.85	*19.5*	*51.2*
CERCOCEBUS (SOOTY-MANGABY MONKEY)									
Male:									
225,926	Young	fuliginosus	Nat. Zool. Pk.	M	—	4,649	95.–	*20.4*	*48.9*
224,806	Adult	fuliginosus	Nat. Zool. Pk.	M	—	3,629	112.–	*30.9*	*32.4*
228,117	Adult	fuliginosus	Nat. Zool. Pk.	M	—	3,856	108.–	*28.–*	*35.7*
Female:									
224,959	Adult	fuliginosus	Nat. Zool. Pk.	E	—	3,175	105.–	*33.1*	*30.2*
CYNOCEPHALUS (MANDRILL)									
Male:									
228,199	Half Grown	maimon	Nat. Zool. Pk.	M	—	3,175	130.–	*40.9*	*24.4*
PAPIO (BABOON)									
Male:									
228,627	Young	babuin	Nat. Zool. Pk.	M	—	3,900	153.2	*39.3*	*25.5*
228,539	Nr. Adult	babuin	Nat. Zool. Pk.	E	—	7,485	172.–	*23.–*	*43.5*
228,628	Young	sphinx	Nat. Zool. Pk.	M	—	2,720	90.–	*33.1*	*30.2*
224,811	Adult	doguera	Nat. Zool. Pk.	M	—	4,990	182.–	*36.5*	*27.4*
225,859	Adult	anubis	Nat. Zool. Pk.	M	—	6,810	212.7	*31.2*	*32.–*
227,818	Adult	sphinx	Nat. Zool. Pk.	Sub-M	—	4,080	177.–	*43.4*	*23.–*
225,867	Adult	sphinx	Nat. Zool. Pk.	M	—	4,763	174.5	*36.6*	*27.3*
228,063	Adult	hamadryas	?	M	—	12,020	142.–	*11.8*	*84.6*
228,169	Adult	babuin	Nat. Zool. Pk.	M	—	10,546	179.5	*17.–*	*58.7*
228,647	Adult	?	Nat. Zool. Pk.	M	—	22,220	213.–	*9.6*	*104.4*

[1] Judged from the growth, dentition, and frequently Zool. Park statement.

[2] Estimated from the general appearance of the animal. A correct appraisal is naturally difficult.

[3] $\frac{\text{Weight of Brain x 1000}}{\text{Weight of Body}}$. Result shows grams of brain per 1000 grams of body mass.

[4] Weight of Body: Weight of Brain.

[5] M = medium. [6] E = emaciated.

Female:									
228,574	Young	babuin	Nat. Zool. Pk.	M	—	10,200	148.–	*14.5*	*1:68.9*
228,662	Young	sphinx	Nat. Zool. Pk.	Sub-M	—	3,060	131.8	*43.1*	*23.2*
224,745	Adult	babuin	Nat. Zool. Pk.	M	—	5,443	162.–	*29.8*	*33.6*
228,538	Adult	obscurus	Nat. Zool. Pk.	M	—	7,710	130.–	*16.9*	*59.3*
228,585	Adult	doguera	Nat. Zool. Pk.	M	—	5,445	161.–	*29.6*	*33.8*
		CYNOPITHECUS (BLACK APE)							
Male:									
224,830	Young	niger	Nat. Zool. Pk.	M	—	3,402	110.–	*31.7*	*30.9*
228,526	Young	niger	Nat. Zool. Pk.	E	—	1,247	77.–	*61.7*	*16.2*
228,543	Young	niger	Nat. Zool. Pk.	M	—	1,410	79.5	*56.4*	*17.7*
228,689	Young	niger	Nat. Zool. Pk.	M	—	2,950	112.3	*38.1*	*26.3*
Female:									
228,167	Young	niger	Nat. Zool. Pk.	M	—	1,814	92.5	*51.–*	*19.6*
228,187	Adult	niger	Nat. Zool. Pk.	M	—	3,452	97.5	*28.3*	*35.4*
		MACACUS (MACÂQUE)							
Male:									
225,823	Young	fascicularis	?	M	—	1,814	54.–	*29.8*	*33.6*
225,834	Young	fascicularis	?	E	—	907	50.1	*55.2*	*18.1*
225,835	Young	fascicularis	?	E	—	1,134	55.–	*48.5*	*20.6*
225,836	Young	fascicularis	?	E	—	1,134	52.–	*45.8*	*21.8*
225,946	Fetus	nemestrinus	Nat. Zool. Pk.	M	—	380	66.–	*173.7*	*5.7*
228,519	Abt. 1 yr.	nemestrinus	Nat. Zool. Pk.	M	—	1,045	94.–	*89.9*	*11.1*
228,612	Young	nemestrinus	Nat. Zool. Pk.	M	—	830	82.5	*99.4*	*10.1*
228,624	Young	rhesus	Nat. Zool. Pk.	Sub-M	—	1,208	83.–	*68.7*	*14.5*
228,634	Young	fascicularis	Nat. Zool. Pk.	E	—	1,280	52.2	*40.8*	*24.5*
228,635	Young	nemestrinus	Nat. Zool. Pk.	M	—	7,710	117.5	*15.2*	*65.6*
228,641	Young	rhesus	Nat. Zool. Pk.	M	—	1,390	73.–	*52.5*	*19.–*
228,642	Young	rhesus	Nat. Zool. Pk.	M	—	1,180	72.–	*61.–*	*16.4*
225,912	Adult	rhesus	Nat. Zool. Pk.	M	—	2,041	100.–	*49.–*	*20.4*
225,933	Adult	rhesus	Nat. Zool. Pk.	M	—	2,722	90.–	*33.1*	*30.2*
228,085	Adult	fascicularis	Nat. Zool. Pk.	M	—	4,310	69.7	*16.2*	*61.8*
228,505	Adult	sinicus	Nat. Zool. Pk.	E	—	3,855	87.5	*22.7*	*44.1*
Female:									
225,812	Young	nemestrinus	Nat. Zool. Pk.	M	—	1,334	88.–	*66.–*	*15.1*
225,832	Young	rhesus	?	E	—	1,588	80.5	*50.7*	*19.7*
225,837	Young	fascicularis	?	E	—	1,361	48.–	*35.3*	*28.3*
225,857	?	rhesus	Nat. Zool. Pk.	M	—	2,268	83.8	*37.–*	*27.–*
228,564	Young	fascicularis	Nat. Zool. Pk.	E	—	1,110	59.–	*53.1*	*18.8*
228,573	Young	fascicularis	Nat. Zool. Pk.	E	—	1,770	84.–	*47.4*	*21.1*
228,604	Young	nemestrinus	Nat. Zool. Pk.	M	—	3,085	103.5	*33.5*	*29.9*
228,613	Young	rhesus	Nat. Zool. Pk.	E	—	1,510	65.5	*43.4*	*23.–*
228,657	Young	nemestrinus	Nat. Zool. Pk.	M	—	2,720	100.–	*36.8*	*27.2*
225,833	Adult	rhesus	?	M	—	2,040	78.–	*26.1*	*38.2*
251,886	Adult	rhesus	Nat. Zool. Pk.	M	—	2,795	80.–	*28.6*	*34.9*
		ATELES (SPIDER MONKEY)							
Male:									
225,866	?	geoffroyi	Nat. Zool. Pk.	M	—	3,812	118.5	*31.1*	*32.2*
228,625	Young	geoffroyi	Nat. Zool. Pk.	M	—	1,709	93.–	*54.4*	*18.3*
224,799	Adult	geoffroyi	?	E	—	1,835	91.–	*49.6*	*20.2*
225,906	Adult	geoffroyi	Nat. Zool. Pk.	E	—	2,268	82.–	*36.–*	*27.6*
228,110	Adult	geoffroyi	Nat. Zool. Pk.	E	—	1,920	95.5	*49.7*	*20.1*
228,580	Adult	geoffroyi	Nat. Zool. Pk.	M	—	2,155	95.–	*44.1*	*22.7*
Female:									
225,904	Adult	geoffroyi	Nat. Zool. Pk.	M	—	2,268	94.5	*41.7*	*24.–*

Catalogue Number	Age	Species	Locality	State of Body	Length of Body cm.	Weight of Body grams	Weight of Brain grams	Brain Wt. per 1000 Body Wt.	Ration of Brain Wt. to Body Wt.
MYCETUS (HOWLER MONKEY)									
Male:									
228,582	Adult	seniculus	Nat. Zool. Pk.	M	—	2,930	47.–	*16.–*	*1:62.3*
Female:									
228,594	Adult	seniculus	Nat. Zool. Pk.	E	—	1,170	48.5	*41.4*	*24.1*
228,575	Adult	seniculus	Nat. Zool. Pk.	M	—	2,725	44.–	*16.1*	*61.9*
CEBUS (CAPUCHIN MONKEY)									
Male:									
225,947	Fetus	hypoleucus	Nat. Zool. Pk.	M	—	176	29.–	*164.8*	*6.1*
225,831	Young	hypoleucus	?	E	—	1,134	61.–	*53.8*	*18.6*
225,856	Young	?	Nat. Zool. Pk.	E	—	1,057	68.45	*64.7*	*15.4*
228,609	Young	capuchinus	Nat. Zool Pk.	E	—	1,205	69.–	*57.3*	*17.5*
228,619	Young	capuchinus	Nat. Zool. Pk.	E	—	1,117	60.4	*54.1*	*18.5*
228,638	Young	?	Nat. Zool. Pk.	E	—	1,270	68.5	*53.9*	*18.5*
228,651	Abt. 2 yrs.	fatuellus	Nat. Zool. Pk.	E	—	1,070	60.2	*56.3*	*17.8*
—[1]	Young	hypoleucus	Nat. Zool. Pk.	E	—	1,073	58.5	*54.5*	*18.3*
224,812	Adult	hypoleucus	Nat. Zool. Pk.	E	—	880	75.–	*85.2*	*11.7*
225,727	Adult	hypoleucus	?	E	—	691	61.–	*88.3*	*11.3*
225,945	Adult	hypoleucus	Nat. Zool. Pk.	M	—	1,021	75.–	*73.4*	*13.6*
228,610	Adult	hypoleucus	Nat. Zool. Pk.	M	—	1,250	74.–	*59.2*	*16.9*
—[1]	Adult	hypoleucus	?	M	—	1,126	68.–	*60.4*	*16.6*
—[1]	Adult	hypoleucus	Nat. Zool. Pk.	E	—	930	66.–	*71.–*	*14.1*
Female:									
228,217	Young	hypoleucus	S. America	E	—	717	59.9	*83.5*	*12.–*
228,225	Young	hypoleucus	S. America	E	—	940	56.–	*59.6*	*16.8*
228,639	Young	?	Nat. Zool. Pk.	E	—	850	65.–	*76.5*	*13.1*
—[1]	?	cabalucus	?	E	—	870	51.5	*59.2*	*16.9*
225,879	Adult	hypoleucus	Nat. Zool. Pk.	M	—	1,247	65.–	*52.1*	*19.2*
225,948	Adult	hypoleucus	Nat. Zool. Pk.	M	—	1,814	65.–	*35.8*	*27.9*
228,602	Adult	hypoleucus	Nat. Zool. Pk.	M	—	1,750	72.–	*41.1*	*24.3*
Sex uncertain:									
225,760	Young	hypoleucus	Nat. Zool. Pk.	M	—	1,001	47.–	*46.9*	*21.3*
MARMOSET (Genus not given)									
Male:									
224,969	Adult	?	?	M	—	204.–	7.35	*36.–*	*27.8*
224,970	Adult	?	?	E	—	172.–	7.1	*41.3*	*24.2*
Female:									
224,961	Adult	?	?	M	—	218.–	7.77	*35.6*	*28.1*
224,967	Adult	?	?	E	—	169.5	7.85	*46.3*	*21.6*
224,971	Adult	?	?	M	—	209.–	8.8	*42.1*	*23.8*
OEDIPOMIDAS (MARMOSET)									
Male:									
228,211	Adult	oedipus	?	E	—	265.5	10.2	*38.4*	*26.–*
Female:									
225,726	Adult	oedipus	?	—	—	360.–	9.85	*27.4*	*36.5*
228,209	Adult	oedipus	?	E	—	290.–	8.–	*27.6*	*32.9*

[1] Not preserved.

Callithrix (True Marmoset)

Male:									
225,903	Young	?	Nat. Zool. Pk.	E	—	175.–	3.4	*19.4*	*51.5*
Female:									
225,854	Young	?	Nat. Zool. Pk.	E	—	102.5	5.5	*53.6*	*18.6*
225,729	Adult	jacchus	?	M	—	95.–	6.95	*73.1*	*13.7*
Sex uncertain									
225,892	Young	?	Nat. Zool. Pk.	M	—	120.–	6.15	*51.2*	*19.5*

Lemur

Male:									
225,923	Adult	varius	Nat. Zool. Pk.	M	—	3,062	31.3	*10.2*	*1:97.8*
228,106	Adult	macaco	Nat. Zool. Pk.	M	—	2,170	21.8	*10.–*	*99.5*
228,139	Adult?	macaco	Nat. Zool. Pk.	E	—	1,899	25.5	*13.4*	*74.5*
Female:									
225,936	Adult	catta	Nat. Zool. Pk.	E	—	1,246	23.35	*18.7*	*53.4*
225,803	Adult	varius	?	M	—	2,720	32.–	*11.8*	*85.–*
228,143	Adult	varius	Nat. Zool. Pk.	E	—	1,250	24.–	*19.2*	*52.1*
228,631	Adult	varius	Nat. Zool. Pk.	M	—	2,040	30.–	*14.7*	*68.–*

LITERATURE

HEREDITY

L'HEREDITE. By Emile Guyenot, small octavo, Paris, 1924, 463 pp.

This is a very convenient introduction to the modern science of heredity. It is rather remarkable in that it casts aside the traditional French attitude favorable to inheritance of acquired characters and indifferent toward the chromosomes as directors of development. The book adopts at once the modern standpoint, as worked out especially by American and English investigators, and does it with the well known clarity of the best of the French writers. The book considers, first, the protoplasmic basis of heredity; next, the laws of hybridization, including disjunction of characters, the factorial theory and genes. It describes in some detail the genes of mice and of drosophila. It treats in detail the behavior of chromosomes that account for segregation and devotes a special chapter to heredity of sex. Linkage in general is then discussed and the facts of localization of factors in drosophila, the variability of chromosomes and its consequences are discussed and considerable attention is given to the remarkable series of variations produced in Datura thru chromosomal irregularities. The author adopts whole heartedly the chromosomic theory of heredity. A chapter is devoted to some deviations in heredity from the Mendelian principles and a final chapter to human heredity. The work ends with a rather extensive bibliography and index. The book is an excellent introduction to heredity for any one who can read French and will naturally have a great influence in France itself.

C. B. D.

HEREDITY OF HEAD FORM. By Schreiner Alette, *Genetica*, Kristiania, 1924. V, 385–454.

The question is raised whether the index-groups denoted as Dolicho-Meso- and Brachycephaly are head-types which are dependent upon a single pair of genes or whether the index in each case is the result of the action of multiple factors. An analysis of the data published by Bryn, Jorgensen and Frets makes it very probable that both the maximum length and breath of the head, as well as the total size of the head, are the result of the action of several independent genes and that, moreover, non-genetic modifications are to a large extent also acting.

In different breeds of dogs the complex nature of the form of the head seems certain from the experiments by Pearson, Nettleship and Usher. The investigation carried out by the author includes 46 human families, the largest covering 4 generations with 48 individuals. In estimating the dimensions of the head the length of the body was also considered. It was found that the geno-typical basis of the different head-types doubtless is rather complex, so that the measuring of the main indices is an inefficient method for the genetical analysis.

The statistical method also fails entirely. It is apparent that a great number of morpholgoical characteristics are inherited independently. It is therefore necessary in each case to get an exact diagnosis of the separate morphological features dealt with and to trace them singly within large families through several generations. It is also necessary to pay attention to different non-genetic causes which may influence the early development of the head and the brain.

In accordance with Toldt it is suggested, that the form of the head may depend upon two different categories of genes, one (the primary factors) influencing the form of the chondrocranium, the other (the secondary factors) affecting the later growth of the skull. To these may be added a third category of genes which influence the early development of the cerebrum. Based on her personal investigations the author regards it as probable that the original form of the chondrocranium is a character dependent upon a single pair of genes, and that to this extent one may speak of primary (or genuine) dolicho or brachycephalic races etc. But this basal form does frequently not express itself in the cephalic index, since the other genes mentioned as well as the non-genetic modifications do also influence the final result.

A. S.

Body-Build and its Inheritance. By Davenport (Charles B.)—*Publ. Carneg. Inst. Wash., Dept. Genetics*, No. 35, 1923, 176 pp., 9 pl.

On the basis of extensive data gathered from various sources, the author reaches the following conclusions:

"Two types of variation in build are to be distinguished: (1) the change in average build that accompanies ontogeny and (2) variations in adult build. The popular idea of build is best expressed as the ratio of transverse chest diameter to stature or (since the chest diameter is rarely known) chest-girth to stature. When only weight and stature are known, the closest approximation to the chest ÷ stature ratio is given by the weight ÷ (stature) ratio and this is taken as the standard index of build. The correlation between the standard index of build and the relative chest-girth is, for males, about 0.45. The index of build of adult males is slightly greater than of females, because of the relatively greater chest-girth of males. The average index of build for males is 2.52 (35.8) and for females 2.43 (34.5). There are marked racial differences in build; but they are not so great as the differences in ontogenetic stages. There are geographical differences in build; the heavy build of northern peoples may be due to a physiological reaction or, in part, to a selective survival of the fleshier individuals or strains. The ontogenetic curve of build, expressed by relative chest-girth. . .shows that at birth chest-girth is about two-thirds of stature and diminishes in the male to the age of 12 years; thereafter on the average, it rises to complete maturity. Build declines temporarily during the first month of life, owing to the physiological difficulties attending adjustment to new conditions. It declines temporarily again, at about 8 months, probably due to the cutting of the incisor teeth. The heavy build of the infant corresponds to that of the short-legged anthropoids. The long-legged slender-build stage of the boy of 12 years persists in the Nilotic negroes and many low-grade feeble-minded. In adult life the changes in build vary with families. In those characterized by slender build there is typically little change. In those characterized by fleshy build there is typically progressive increase in weight to 50 years. In some families weight fluctuates greatly at different periods of adult life. In general, though with numerous exceptions, a fleshy adult build is foreshadowed in plump build in childhood. Mass studies on adult build give a polygon of distribution which is skew, the mode being toward the slenderer end of the polygon. There is evidence of more than one mode, and hence that there are two or more types of build. For purposes of description five classes of build are recognised—very slender, slender, medium, fleshy and very fleshy. The diseases associated with very slender and slender build are: tuberculosis, pneumonia, "nervousness", melancholia. The diseases associated with very fleshy or fleshy build are: diabetes, nephritis and dropsy, apoplexy and arterio-sclerosis and paralysis accompanying it; also numerous diseases of the alimentary tract. Fleshy parents have, on the average in our data, larger families than slender parents. Regression towards mediocrity is less striking in the offspring of slender than of fleshy parents, suggesting that fleshy parents carry not only genes for fleshiness but also for slenderness, while slender parents more rarely carry genes for fleshiness. The offspring of two fleshy parents are twice as variable as those of slender parents. The hypothesis is indicated that genetically build is controlled by multiple factors, with fleshiness tending slightly to dominate over slenderness. There is a marked tendency for persons of similar build (or with potentialities for such) to intermarry. Dissimilar builds are selected against. Two slender parents of slender stock have rarely any progeny whose index of build exceeds 2.2, or just above the upper limit of the slender group. In general, the progeny of slender parents are relatively slightly variable. The slender parents are apparently of two kinds; those carrying only one kind of factor for fleshy build and the other two such gametic factors. The progeny of the former are very slightly variable; those of the latter more variable. By comparing coefficients of variability instead of indices, and by making allowance for the greater range of the fleshy class, it still appears that the progeny of fleshy parents are relatively and per unit range more variable than the progeny of slender parents. Absolutely the offspring of the fleshy parents are, as stated, twice as variable as of slender parents. The matings of slender parents and fleshy parents of fleshy stock yield a variable progeny. The variability is between that of the progeny of slender matings and that of the progeny of fleshy matings. There is evidence of partial dominance of fleshiness. The mating of two heterozygous parents produces, in general, an exceptionally variable progeny. This is one of the strongest evidences of the presence of genetical factors in build. Many, if not most, parents of medium build belong to biotypes with 1 or 2 independent factors for build. Consequently the progeny of medium X medium matings is often strikingly invariable. The "back-cross" of a heterozygous parent with a slender parent on the one hand or with a fleshy parent of fleshy stock on the other, gives a variable progeny, whose mode is shifted toward fleshiness; but which shows a tendency to fall again into the slender (or fleshy) and medium-fleshy grandparental types. Variations in build are not to be accounted for merely by variations in intake and out-go of calories, but also by the endogenous factors that determine the "economy of nutrition" or the cost in energy of adding an additional kilogram of weight to the body. The factors involved in producing differences in these respects are hereditary factors. The hereditary factors probably work through the intermediacy of special organs that influence metabolism, notably the endocrine glands. The latter thus intermediate between the chromosomal constitution, on the one hand, and control of metabolic processes, on the other. The number of factors involved in very fleshy build is, in some cases at least, three independent ones. But the number is probably not the same in all biotypes. Probably in some there is only one, in others four or more. The factors probably influence the functioning of the thyroid, pituitary and perhaps other glands."

THE BIOMETRICAL STUDY OF HEREDITY. By Fisher (R. A.)—*Eug. Rev.*, 1924, XVI, No. 3, 189–210.

Two very good lectures delivered at the London School of Economics, June 6th and 11th, 1924. The conclusions reached under our still very limited biological perspective are: "Mendelism is the only type of inheritance yet demonstrated in fully investigated cases; it is however, theoretically possible that blending inheritance might exist in quantitative characters. The only quantitative characters which have been sufficiently studied are those of man, and here there is definite evidence both of segregation and of dominance. This suggests strongly that quantitative characters also are transmitted by Mendelian factors. If all inheritance falls within the Mendelian scheme, then mutations must be exceedingly rare events. Pure line experiments demonstrate that mutations are in fact very rare, and consequently that selection is the only agency by which species can be modified to any appreciable extent. This conclusion gives a special importance to the study of the nature of the selection actually in progress in civilized man."

THE NUCLEUS IN RELATION TO HEREDITY. By Gwynne-Vaughan (Helen)—*Eug. Rev.*, 1923, XV, No. 2, 402–408.

"One of the most remarkable phenomena of biology is the similarity of the nuclear structures and their history throughout the animal and vegetable kingdoms; there are innumerable minor differences, but the close resemblance in nuclear organisation, the close resemblance of the chromosomes and the close resemblance of the germ cells and corresponding products in nearly every form of plant and animal life, is so striking that great importance must be attached to it. It would probably be accurate to say that, with the exception of certain protozoa, bacteria and blue-green algae, all living organisms are built up of cells with the same essential characters. These characters, moreover, are so distinctive that they form a strong argument in favor of a common origin, and they suggest a common method of inheritance."

Certain new phases of heredity are now receiving attention. It is becoming more and more evident that "many characteristics depend for their manifestation on the interaction of two or more hereditary characters. . .Interacting characters may be associated in the same chromosome or they may be independently inherited. In favorable circumstances. . .an old linkage may be broken down or a fresh one established. . .recent studies on the physical basis of inheritance suggest that there may be created afresh from time to time combinations of characters so linked as to form a new and valuable element in inheritance."

IMMUNE SERA AND CERTAIN BIOLOGICAL PROBLEMS. By Guyer (M. F.)—*Am. Naturalist*, 1921, LV, 97–115.

——SEROLOGICAL REACTIONS AS A PROBABLE CAUSE OF VARIATIONS.—*Am. Naturalist*, 1922, LVI, 80–96.

——THE PRODUCTION AND TRANSMISSION OF CERTAIN EYE DEFECTS.—*Trans. Internat. Congr. Ophthalmol.*, Wash. 1922, repr. 21 pp.

——ORTHOGENESIS AND SEROLOGICAL PHENOMENA.—*Am. Naturalist*, 1922, LVI, 116–133.

——EXPERIMENTS IN PRODUCTION OF TYPHOID AGGLUTININS IN SUCCESSIVE GENERATIONS OF RABBITS. By Guyer (M. F.) and E. A. Smith.—*J. Infec. Diseases*, 1923, XXXIII, No. 6, 498–525.

——THE GERM CELL AND SEROLOGICAL INFLUENCES. —*Proc. Am. Philos. Soc.*, 1923, LXII, No. 5, 274–291.

——FURTHER STUDIES ON INHERITANCE OF EYE DEFECTS INDUCED IN RABBITS. By Guyer (M. F.) & E. A. Smith—*J. Exp. Zool.*, 1924, XXXVIII, No. 4, 449–475.

Important publications, dealing with the subject of transmission of acquired characters. Professor Guyer experimenting on rabbits (in the main), with various sera, has been able to produce eye and other defects that have been and are still being transmitted to the progeny. But these papers deal with the subject also in a broader way, of which the following quotation (from the "Germ-cell and Serological Influences"), which incidentally also touches man, is a good example: "Whatever we may believe about the degree of preformation which exists to-day in the mechanism of heredity, it is absurd to assume that in the simpler primitive protoplasn from which modern forms have evolved there could have been genes of the characteristics of all the organisms now in existence. Whatever individual development may be, we must assume that racial evolution was epigenetic. While doubtless in a sense man lived potentially in some primitive protozoan-like creature, actual material antecedents of his existing attributes were no more present in this ancestral creature than specific determiners for the oceans, continents, and topographical features of the world to-day were present in the original nebula which preceded our solar system. The great central problem of evolution is just this very one of how the determinative accumulations which exist in germ-cells to-day have been incorporated step by step into this erstwhile primitive protoplasm. Certain possibilities have become realities and concomitantly as a basis of this reality the old mechanism has in part been altered or a new mechanism has come into being which persists as a part of the established constitution of the germ-cell."

DĚDIČNOST RÚZNOBAREVNOSTI OČI (HETEROCHROMIA IRIDÍS) U CLOVEKA. (Inheritance of *herterochromia iridis*). By Matiegka (J.) and A. Brozek.—*Anthropologie*, Prague, 1924, II, 98–105.

The authors describe the color of the hair, the eyes and heterochromy of the eyes (eyes of different coloring) in a large family group of four generations. "If we divide the eyes into two groups according to Hurst and Davenport, distinguishing the dark types as duplex and the light types as simplex, we see that the inheritance of eye color follows on the whole the rules laid down by the aforesaid authors; that is, the duplex types are found to be dominant over the simplex."

The light color of the eyes and fair hair increased for two generations, perhaps in consequence of a relatively more frequent crossing with light eyes and fair-haired members of the neighborhood, brown eyes and dark hair decreasing. A heterochromy of the iris was noticed in five families, altogether in five persons. Its appearance does not contradict the notion of simple Mendelian heredity and a free combination of this defect with other hereditary characters. But the peculiarity is not dominant. On the contrary all the observed cases in this group may be explained by the supposition that the heterochromy is a *recessive* character. Its appearance might be compared with that of the same character in the family described by Cockayne.

LE POIDS DES ENFANTS NÉS A TERME OU AU VOISINAGE DU TERME. By Vignes (Henri) *Rev. Anthropol.*, 1924, XXXIV, Nos. 3–4, 152–159.

This paper brings data which deserve to be quoted in detail. They show clearly two facts that must henceforth be considered in all studies on the newborn. One is that the weight (which naturally also means the size) of the child at birth increases very perceptibly with the length of gestation; the other being that the children of multiparae are in general heavier than those of primiparae.

ZYGODACTYLY AND ITS INHERITANCE. By Schultz (A. H.)—*J. Hered.* 1922, XIII. 113–117.

Webbing between fingers and toes is called zygodactyly. It is normally present in early embryonic stages and may in rare instances persist throughout life as a developmental arrest. In the foot the persistence of the webbing seems to occur always between the second and third toes.

Skin-fusion between these toes is found in many marsupials and in the Siamang apes. When present in man the tendon of the long extensor muscles for toes II and III is unsplit for an unusually long distance. In no zygodactyl family does the anomaly skip a generation. The chance for the female to transmit webbed toes is very much less than for the male and female progeny in general is less apt to inherit zygodactyly than male progeny. A.H.S.

INHERITED ABNORMALITIES OF THE FINGERS. II. SHORT THUMBS. By Hefner (R. A.) *J. Hered.*, 1924, XV, No. 10, 433–439.

"Brachymegalodactylism is the condition of having abnormally short thumbs. The trait is believed to be a pure Mendelian dominant. Brachmegalodactylism may affect one or both thumbs without definite ratio. One case here reviewed is without hereditary explanation. It may be an original mutation. The seat of the anomaly lies in the terminal phalanx of the affected thumb. The relation of unilateral brachymegalodactylism to the bilateral development of the embryo is not clear. The location of nine unrelated cases of the trait without extended effort seems inconsistent with the general conception of the stability of species."

THE CHILD

THE GROWTH OF CHILDREN AS INFLUENCED BY ENVIRONMENTAL AND HEREDITARY CONDITIONS. By Boas (Franz)—*School & Society*, 1923, XVII, 305–'08.

Consideration of extensive data on stature, weight and dentition, leads the author to the following conclusions:

"It is not possible to establish a physiological age of individuals by means of the observation of a single feature because each physiological function has its own characteristic correlation to the chronological age of the individual, and it is possible to form a correct judgment of the general physiological development of the individual only by taking into consideration all the different conditions of physiological development which are reached by the various organs of the body. The differences between the growth curves of different European types are small as compared to the variations that may be brought about by different social environments, but beginning with adolescence the effect of the hereditary growth curve makes itself felt and outweighs the environmental effect. In all probability each racial type has its own growth curve."

INDICES OF NUTRITION. By Clark (Taliaferro)—*Publ. Health Rep.*, 1923, XXXVIII, No. 23, 1239–1259.

The study shows the unsatisfactory status of present tests of the physical stature of children:

"For the purpose of comparing different indices of nutrition, a group of 506 children who had the following qualifications were selected from much larger numbers: (a) Native white of native parentage and native grandparents; (b) no physical defects; and (c) nutrition "good" or "excellent" as judged from clinical evidence."

These children were selected after careful physical examination as being in good health so far as the medical examiner (U. S. Public Health Service) could determine.

Three standards of weight were applied to them. It was found that according to the Wood standard (height-weight-age tables) 20 per cent of these children were more than 10 per cent underweight; according to Dreyer's standard (stem length and chest circumference tables), 13 per cent of the children were more than 10 per cent underweight; and according to Pirquet's "pelidisi" method, 17 per cent had pelidisi of 94 or less and were underweight according to this standard.

A cross tabulation was made to ascertain whether children underweight according to one standard were underweight according to other standards. Although the percentage of children who were underweight did not vary greatly when different standards were applied (13, 17 and 20 per cent), many individuals classed as underweight by one standard were classed as normal, or in a few cases, overweight, by one or both of the other standards. Out of 506 children 210 were classed as underweight by one or more of the three standards used; of these 210 cases, all three standards agreed on 15 cases as being underweight.

These children were selected as being the best specimens of health that could be found among school children. In spite of this fact, one-fifth of them were underweight according to the standard most frequently used in school health work in the United States.

DO HEIGHT AND WEIGHT TABLES IDENTIFY UNDERNOURISHED CHILDREN? By Dublin (Louis I.) & John C. Gebhart. 8°, 1924, N. Y. Asso.. for Imp. Cond. of the Poor, 23pp., 8 charts.

Too much emphasis, and undue confidence, has been placed upon so-called standard height and weight tables in the search for under-nourished children. When 75 per cent. and more of the children presenting unmistakable clinical signs of mal-nourishment are missed through the use of an accepted height and weight table, it is time to call for a re-examination of the current basis for nutrition work among children.

In a survey of some 4,000 children of Italian parentage in the Mulberry District of New York City under the care of the ASSOCIATION FOR IMPROVING THE CONDITION OF THE POOR, it was found that 77.2 per cent. of the boys and 67.1 per cent. of the girls judged to be mal-nourished on clinical grounds, would have been missed if reliance had been placed entirely on the usual weight tables with a seven per cent. limit of underweight. Using the 10 per cent. limit of underweight, 89.8 per cent. of the undernourished boys and 81.8 per cent. of the undernourished girls would have been overlooked through use of the weight tables alone. These are grave deficiencies in an instrument which is designed to sort out individuals for the correction of so important a defect as mal-nourishment!

An experienced pediatrician was employed by the Association to examine the children for the discovery of physical defects, as well as to make a diagnosis of defective nutrition. This physician had had considerable experience in dealing with undernourished children, and it was decided to rely upon his judgment as to the nutrition of the children rather than to place blind reliance upon an arbitrary height-weight standard. While his judgment was largely determined by apparent underweight in respect to height and age, other symptoms such as flabby muscles, lustreless eyes, apathy of bearing, poor color, poor posture, and a relative absence of subcutaneous fat, were taken into account in assessing the child's nutrition. The children were entirely stripped and the examinations were unusually thorough. A record was also taken of the child's height and weight at the time of the examination. It was possible, therefore, to make some comparison between the diagnoses of mal-nutrition as established by the physician on the one hand, and the proportion of cases which would have been placed in the undernourished group if reliance had been placed only upon the generally accepted tables of height and weight.

The tables confirm the doctor's judgment as to well-nourished children almost completely. For, 97.6 per cent. of the boys and 94.5 per cent. of the girls considered well-nourished by the physician would have been so classified by those using the standard tables with the seven per cent. limit of underweight as a guide. Applying the 10 per cent. limit of departure from average weight, 99.5 per cent. of the boys and 97 per cent. of the girls judged to be well-nourished by the physician would have been so classified if the tables alone had been used. But this, certainly, is no recommendation; for the purpose of the tables is primarily to provide a ready, dependable means for identifying children who really need the attention of nutrition workers.

It is obvious that so far as Italian children living in a congested district of New York City are concerned, the standard tables have little or no value for selecting the *undernourished*. From the evidence in hand, the use of the height and weight tables alone in the detection of undernourished children seems to be unsound and misleading. The trouble is that children of average weight may be and often are in poor condition as to their nutrition. The failure of the standard height and weight tables in this case may be due, in part, to the fact that the children examined deviate widely from the national type. But the method itself seems to be unsound in principle. For one thing, the children in this area of New York City are considerably below the average of height and weight shown in the standard tables. These children tend to be rather shorter and stockier than the general average of children throughout the country. The fact that the scale fails in the selection for medical and educational care of these children whose nutrition is seriously impaired, suggests that before any standard table of heights and weights is used generally in nutrition work, some regard must be had for the innate build-characteristics of children of the definite race stock under consideration. But, furthermore, the failure of the scale in this particular application emphasizes most strongly the need for dependence upon thorough medical examination of children by a competent pediatrician. Nutrition work cannot be safely carried out unless the children requiring care are in the first instance selected on the basis of a thorough going physical examination.

A more detailed report will be made later. The present note is a summary of an analysis made jointly by the Association for Improving the Condition of the Poor and the Metropolitan Life Insurance Company.

L. I. D.

EIGENART IN ENTWICKLUNG, BAU UND FUNKTION DES WEIBLICHEN KORPERS UND IHRE BEDEUTUNG FÜR DIE GYMNASTIK. By Matthias (E.)—8°, Bern, 1923, (V. P. Haupt), 23 pp.

An able collection of data from a widely scattered literature on the morphological and physiological secondary sex-differences, including a discussion of some of the growth differences between boys and girls.

The author, who, through careful investigations has placed the study of the influence of exercise on body proportions on a scientific basis, concludes that woman is not built to rival man in athletic accomplishments.

A. H. S.

THE FETUS

Observations on Colobus fetuses. By Schultz (Adolph H.)—*Bull. Amer. Mus. Nat. Hist.*, 1924, XLIX, 443–457.

As a contribution to the comparative study of prenatal growth, fetuses of the Colobus monkey are described in detail, their body proportions, in particular, are compared with those of adult Colobus and of human fetuses of corresponding development. The following main points distinguish the monkey fetus from the human fetus: In the former the trunk is relatively longer and narrower, the extremities are shorter in relation to the trunk length, and the head is relatively smaller, the greatest difference existing in the height diameter. While most of the proportions in Colobus and man are more or less different, there exists a close correspondence in many of the growth changes in these proportions. As examples, it may be mentioned that, in both, the lower limb grows faster than the upper one, the nasal index drops with advancing age, and the cervical and thoracic regions of the spine decrease in relative length and the lumbar portion increases. Ossification in Colobus proceeds in close accord with that in man.

Carpal sinus hairs, common among Prosimiae, were found in the Colobus monkey in a fetal stage, where it seems to be the only representation of these hairs among catarrhine monkeys.

A. H. S.

PATHOLOGY

THE BIOLOGICAL SIGNIFICANCE OF PATHOLOGICAL CHANGES. By Nicholson (G. W.) *Sci. Prog.*, 1924, XVIII, No. 72, 578–586.

An important note calling attention to the valuable biological indications afforded not seldom by pathology. It is a dictum in biology that adult cells in regenerative processes can only reproduce alike. But pathology demonstrates that this concept is erroneous and that there are many instances of "heterotopic regeneration" even in adult man, where under changed or "pathological" environment cells change both their form and function. Thus the epithelial lining of the inside of the gall bladder often changes under pathological conditions of the organ into typical mucous or into gastric-like glands, with their characteristic secretion. The epithelium of the large intestine may equally, under abnormal conditions, differentiate with gastric epithelium. The peritoneal epithelium of diseased ovaries in the domestic fowl may alter so that the new cells produce spermatozoa; etc. "All these pathological reactions indicate that the power of cells to undergo regeneration into a different specific type is a much more widely distributed phenomenon in the animal kingdom than is generally supposed. The higher the animal the less does it become, but many instances of its action are to be observed even in man." In an effort at explanation of these phenomena the author inclines to the theory of *epigenesis*, which conceives the final specific structure of a cell as not predetermined from the beginning, but rather as the visible expression of many alternate possibilities or 'potencies'. . "The normal structure of a finished organ is nothing more than a function of location, a reaction to the normal environment, since it changes even late in life with a pathological alteration of the latter."

THE ANTIQUITY OF DISEASE. By Moodie (Roy L.)—16mo., Chicago (The University of Ohio Press), 1923, 148 pp.

The author, who has occupied himself with the subject for a number of years, gives in this small volume an abstract of his previous publications and of the rich additional material in his hands. He is now preparing a larger work on ancient human as well as animal pathology, which, together with a fuller bibliography, will be welcome to anthropology. The field of comparative human pathology is large and full of difficulties, but also full of promise.

PALEOPATHOLOGY: An Introduction to the Study of ancient Evidences of Disease. By Moodie Roy L. 8°, (Univ. Illinois Press, Urbana), 1923. pp. 1–567, figs. 1–49, plates i-cxvii.

This volume contains a summary of all evidences of the origin and development of disease such as may be traced from the pathological lesions found on the fossil bones of the ancient races of man and extinct animals, as well as from the associations of early animals of the Paleozoic. It does not treat of events of modern history. The method of treatment has been to follow the succession of evidences of disease seen in the geological record; thus, the early chapters treat of the most ancient evidences of disease and the later chapters discuss the paleopathology of man. The volume closes with an account of the ancient Peruvians.

In the introduction the reader finds an outline of the field which the writer proposes to cover, as well as discussions of geological matters to adapt the text to those who are not familiar with the facts of geology. The immense stretch of time during which disease has been present on the earth is evidenced by certain parasitic and commensal conditions found in the middle Paleozoic. It is suggested, however, that the natural immunity of the early animals protected them from the ingress of disease until such time as the stock became weakened. A summary of the pathological conditions among fossil plants is given by Dr. Edward W. Berry in Chapter III.

Eight chapters are devoted to a discussion of pathological conditions among fossil animals. The subjects treated are fracture and callus, arthritides, caries and alveolar osteitis, chronic infections, parasitism, bacteriology, opisthotonos, and the extinction of races. Disease is not proven to be an important factor in extinction of races, in so far as the record may be read.

The last four chapters, of unequal length, are divided among the subjects-pathology of the early human races, diseases of the ancient Egyptians, the paleopathology of the North American and the Peruvian Indians of pre-Columbian times. Ancient man is thoroughly discussed so far as the record is known. The lesions known are discussed and some of them illustrated. Evidences of surgery such as trephining, cauterization, amputation and the treatment of fractures demands considerable attention. The ancient Egyptians provide the most complete records of pathology because they have been more thoroughly studied. and Chapter xiii reviews the work of Fouquet, Ruffer, G. Elliot Smith, F. Wood Jones and other students of this subject. The paleopathology of the North American Indians is treated in an original way by presenting the study of a large collection of supposedly pre-Columbian Indian remains which was loaned the writer for a long period of time by the American Museum. Pre-Columbian evidences of disease among the ancient Peruvians are found represented on pottery, in small images, and in skeletal material. Ancient Peru stands next to Egypt in being more thoroughly known, but there are still wide gaps in our knowledge.

An extensive bibliography of several hundred titles closes the volume. The work, while admittedly a compilation, contains much new material and reveals the results of studies otherwise unpublished. The book is thus made a source-book of this interesting subject.

R. L. M.

STUDIES IN THE PALAEOPATHOLOGY OF EGYPT. By Ruffer (Sir Marc Armand); ed. by Roy L. Moodie. *Univ. Chic. Press*, 1921, 8°, i-xx and 1–372, 71 pl.

This volume was prepared under the supervision of Lady Alice Ruffer as a memorial to her husband who lost his life in the war. The nineteen reprinted essays, comprising the bulk of the book, represent the results of one of Sir Armand Ruffer's keenest interests during the twenty years of his residence in Egypt; that of the evidences of disease in ancient

Egyptian mummies. As such the book cannot fail to interest anthropologists. The present work is the first separate volume to be devoted entirely to a discussion of Palaeopathology, although there are several large anthropological memoirs which have devoted considerable space to this topic.

The introductory portions of the book comprise a biographical sketch of Sir Armand and a list of his writings. A short note on the histology of ancient Egyptian mummies announcing the author's discovery of a new method of treating mummified tissues for histological examination opens the reprinted portion of the book. The next essay, reprinted in its original German, details the evidences of tuberculosis in a mummy of a priest of Ammon, 1000 B. C. The conclusive nature of the diagnosis is found in a well preserved psoas abcess. This is one of the oldest evidences of Pott's disease known, although Bartels, Prunières and others have written of several suggestive occurrences of this disease in Neolithic times. A pustular eruption resembling small-pox in a mummy of about 1200 B. C. marks one of the earliest landmarks in this form of dermatology.

Ruffer's discussion of dwarfs, many of which are commonly represented in ancient times, as achondroplastic will form an interesting addition to our knowledge of the anthropology of small people. The paper is illustrated by copies of figures from ancient monuments.

Three of the papers are devoted to histological studies of ancient mummies; one of these elaborately illustrated. One paper discusses the existence of spondylitis deformans in a Miocene crocodile. There is a timely review, from the pathological viewpoint, of Neolithic and other ancient evidences of trephining. There are two extensive papers dealing with osseous lesions in ancient Egyptian times. One paper, on the Abnormalities and Pathology of ancient Egyptian Teeth, was reprinted from this Journal.

The closing paper of the series is a very interesting discussion of the hereditary effects of intermarriage. Ruffer takes his evidences from the statues, engravings, and mummies of the royal families of ancient Egypt; the data including the ruling families from the eighteenth dynasty to the last of the Ptolemies. Among the offsprings of the many incestuous marriages of the royal families of ancient Egypt there are no recorded cases of sterility, idiocy, deaf-mutism, and the average duration of life was relatively long; the average length of life of the Ptolemies being sixty-four years. He defends his conclusions on such meager data: "Had the families of these monarchs suffered from some hereditary disease, the local satirists would have made capital of it, with due exaggeration, and the fact that they were silent is of the utmost importance."

An appendix giving a chronological list of dynasties, rulers, and the chief events in Egyptian history enables the reader readily to correlate the study of pathology with events of a political nature.

R. L. M.

TYPHUS FEVER ON THE SAN JUAN INDIAN RESERVATION, 1920 AND 1921. By Armstrong (Charles)—*Pub. Health Rep.*, 1922, XXXVII, No. 12, 685–693.

During the latter months of 1920 and the first half of 1921, 63 cases of typhus fever with 27 deaths occurred on the San Juan Navajo Reservation. The introduction of the contagion is not definitely known, but in all probability it came from Mexico where typhus is endemic. The disease affected persons of all ages from a child 21 days old to a man of 69. It was somewhat more frequent and also more fatal in males than in females. The epidemic was eradicated by the Public Health Service. A previous small epidemic of typhus occurred among the Navajo in 1914 with 27 cases and 4 deaths. Interesting details are given as to the conduct of the campaign against the epidemic.

TUBERCULOSIS AMONG THE NORTH AMERICAN INDIANS. Report of a Committee (headed by Dr. George M. Kober) of the National Tuberculosis Association. *Senate Comm. Print*, 8°, Wash. 1923, 101 pp.

The report deals with the history of the subject, the present status of the Indians in this respect, the causes and statistics, the measures taken and recommended. Comparative data on the whites and negroes are included.

ATLAS UND GRUNDRISS DER RACHITIS. By Wohlauer (Franz)—*Lehmann's Medizinische Atlanten*, Vol. X, Munich (J. F. Lehmann); small 4to, 66 pp. text, 27 pp. bibliography, 10 + 77 figs., 12 plates. (Price, bound, $4.70).

Essentially a pathological treatise, dealing with the causes, nature and therapy of the disease. Of interest to physical anthropology are sections on changes in skull and bones, and the influence of the disease on stature. The extensive bibliography will be found very useful.

Good as the book is, it does not cover all the rachitic changes in the bones and particularly the skull.

THE AGE FACTOR IN HYPERTROPHIC ARTHRITIS. By Willis (Theodore A.)— *J. Bone and Joint Surgery*, 1924, VI, No. 2, 316–325.

"Hyperthropic bone changes represent the reaction of bone and joint structures to the wear and tear of life. They are more pronounced in certain types of individuals and are aggravated by continued local irritation of any character.

"These changes rarely occur before the thirty-fifth year of age but are progressive thereafter. They may exist to a marked degree without clinical symptoms. Being the result of metabolic changes rather than the cause, their presence does not prohibit relief from such symptoms.

"The bone changes are permanent. Treatment of the symptoms must be directed toward the removal of all possible sources of continued irritation. These include mechanical strains, focal infections, intoxications and absorptions, any or all of which factors may be present in a given case."

(ANTHROPOMETIC STUDY OF OXYCEPHALIC CRANIA, with Special Regard to Pathological Conditions of the Visual Apparatus in such Skulls. In Czech; resumé in French).—*Anthropologie*, Prague, 1924, II, No. 2, 81–86.

Examination of 17 oxycephalic skulls has given the author interesting results which throw light on the causes of the visual troubles with which the possessors of such skulls are often afflicted. The specimens show markedly subaverage cranial capacity with slightly higher but shallower orbits than found in the normal type of the people to which they belong. There are many signs that point to an increased intracranial pressure in these skulls and this probably accounts for the disturbance of the visual organs.

A CASE OF CONGENITAL SCOLIOSIS DUE TO THE SUPPRESSION OF HALF A VERTEBRA. By Wakely (C. P. G.)—*J. Ant.*, Jan. 1923, LVII, pt. 2, 147–8.

X-ray examination of the spinal column of a boy of six with congenital scoliosis "clearly revealed a wedge-shaped half vertebra in the region of the eleventh thoracic vertebra on the left side. There were only eleven ribs on the right side while on the left twelve were present, the eleventh articulating with the half vertebra. . . This case seems to be one of suppression of the right half of the body of the eleventh thoracic vertebra along with the eleventh rib on the right side. This deformity must arise very early in intra-uterine life and is no doubt due to an error in segmentation."

MECHANISM OF THE NORMAL FOOT AND OF FLAT FOOT. By Morton (Dudley J.)—*J. Bone and Joint Surg.*, 1924, VI, No. 1, 56–90. Repr.

"In the analysis of Flat Foot and its allied disorders, the following points stand out as the most important ones: (1) The disorder is essentially and primarily a faulty posture of the os calcis, by which an *improper distribution* of body-weight and muscle force is transmitted to the fore part of the foot through its two channels, the scaphoid and cuboid bones; in the fore part of the foot, functional derangement and subsequent deformity is purely secondary to the improper distribution of forces thrown upon it from the posterior half. (2) The nature of the disorder is a loss of the normal balance of the forces passing through the foot so that the unbalanced structure is caused to roll inward (pronate). This movement increasingly exaggerates the faulty distribution of pressure and at the same time breaks down the resistance of the tissues which attempt to oppose the abnormal movement. Hence a vicious circle is formed. (3) The plantar ligaments are the only real weight-supporting soft structures of the foot; the lateral muscles and ligaments are merely controlling in their actions and incapable of sustaining any considerable amount of body-weight. (4) The early movement of the faulty posture is almost directly lateral; the resulting progressive slant, however, of the calcaneal facets causes an inward shifting of body-weight and the creation of a strong lateral thrust, which together constitute an overpowering burden upon the relatively weak lateral structures. (5) This burden is termed a "false load" because it is a new and abnormal element of strain thrown upon lateral structures and by them is merely transmitted back again upon the leg and foot. This "false load" constitutes the pernicious element of this type of foot disorder and should be viewed as a vicious development that is comparable to a neoplastic growth; it has no useful purpose, and is solely destructive in its effects. (6) Bone changes ultimately occur which accord with the disordered movements of force and the uneven contact of joint surfaces. The changes are widely scattered to all the bones of the foot, each bone presenting a relatively small share of the total deformity."

THE BIOLOGY OF DEATH. By Pearl (Raymond), 12mo. Phila. & Lond., 1923, (J. B. Lippincott & Co.)

In this volume[1] the author endeavors "to bring together under a unified viewpoint some of the more important contributions which have been made to our knowledge of natural death from three widely scattered sources namely general biology, experimental biology and statistical and actuarial science." The field approached is shown from the following captions: The Problem; Conditions of Cellular Immortality; The Chances of Death; The Causes of Death; Embryology and Human Mortality; The Inheritance of Duration of Life in Man; Experimental Studies on the Duration of Life; Natural Death, Public Health and the Population Problem. The little book, which does not easily lend itself to a brief summary and well deserves to be read *in extenso*, is full of advanced reasoning and stimulating suggestions. The main stress is laid on the rapidly approaching overpopulation of many countries and the dangers it involves. The author advances no cure for this, being content to point out—which he does more strongly than has been done before—"that population growth presents a problem fast becoming urgent; a problem that in its overwhelming significance and almost infinite ramifications touches upon virtually every present human activity and interest, and in particular upon the activities comprised in the terms public health and hygiene."

DISEASES WHICH KILL MORE WOMEN THAN MEN. The death rates for the great majority of the important diseases are higher among men than among women.

There are, nevertheless, a number of diseases, which, year after year, record relatively higher mortality among girls and women. In most such cases the reason for the excess is obvious. Certain diseases, including cancer, organic heart disease, and apoplexy, show higher death-rates among women because this sex has the longer average life span and more women than men live to reach those mature ages where most of the deaths from cancer, cardiac conditions, and apoplexy occur.

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[1] For reviews of preliminary publications on the subject see earlier numbers of this Journal.

There are, however, a number of other diseases which show, year after year, higher deathrates among females, and for which the reason is by no means clear. The figures for whooping cough, for example, have shown a higher incidence among girls than among boys, which is contrary to what occurs with mealses, scarlet fever, and dipththeria—the other principal epidemic diseases of childhood.

Then again, tuberculosis of the intestinal tract, contrary to other forms of tuberculous diseases, kills more women than men. We have never seen a satisfactory explanation for this phenomenon. It is a fact, however, that the excess in the female mortality is confined to the age periods between ten and fifty years; and this suggests that the sex difference *may* be due to conditions related to maternity. There is also a possible relationship between non-puerperal diseases of the female genitals and intestinal tuberculosis. It has been suggested by one authority that some diseases of the female sex organs reduce the powers of resistance and enable the bacillus of tuberculosis to gain a foothold. In such cases tuberculous peritonitis often follows diseases of the uterus and adjacent organs.

In the United States, women suffer from pellagra to a far greater extent than men. The susceptibility of the former is far more pronounced in America than in Europe. The great preponderance of females over males and the much higher mortality call for explanation. The difference is not so pronounced after age 55 as at the younger ages.

Affections of the endocrine glands, (the thyroid, the parathyroid, the pituitary, the adrenal, and the pancreas) uniformly cause much higher mortality among females. Women are much more frequently attacked and this is especially true of all forms of goitre. In Addison's disease, a rare affection of the suprarenal capsule, males are more frequently attacked than females, but females, on the other hand, show the higher deathrate.

Diabetes is a disease with a most decided sex incidence. We have frequently commented on the favorable turn in the mortality from this disease, as shown in 1923 and the early months of 1924. When figures are available by sex, it will be interesting and important to determine whether this decline in the deathrate has occurred in each sex; for it is a fact that in diabetes mellitus, men are more frequently affected than women—at least more men than women are *treated* for diabetes—but more women than men *die* of the disease. On the face of these data a first-hand deduction would be that the disease has a much higher case-fatality rate among women. One prominent authority on diabetes, however, suggests that the apparent preponderance of the disease in men may be due to some extent to the larger percentage of men who are examined by life insurance companies. The result is that with women, much more than with men, the disease goes undetected. He suggests, furthermore, that the fact that more men than women receive special medical treatment for diabetes, and that, at the same time, more women than men die of the disease, is evidence in favor of the effectiveness of the present treatments.

Chorea, or St. Vitus's Dance, a disease that affects children for the most part, is far more prevalent in girls than in boys. It sometimes terminates fatally, and deaths chargeable to it result directly from complications, rather than from chorea itself. It records, year after year, many more deaths among girls than boys and even at the advanced ages, where relatively low mortality occurs, the same strong sex incidence prevails. Mental conditions, except general paralysis of the insane, cause 50 per cent. higher mortality among women than among men.

Anemia, a disease due either to reduction in the amount of blood as a whole, or of the blood corpuscles, or of certain constituents of the blood, is another condition which causes many more deaths among females than males. This is true at every age of life. One type of anemia, known as chlorosis, is, in effect, definitely a disease of girls, the age of onset being usually between the fourteenth and seventeenth year. One prominent medical authority states that it is doubtful if males are ever affected with chlorosis, but he does not venture any opinion as to *why* this is true. One type of anemia, known as pernicious anemia, is more common among males.

Liver and gall-bladder diseases, with the exception of cirrhosis, show, year in and year out, such strong preponderance in female mortality that there can be no doubt whatever of the existence of a definite cause for this phenomenon. In the case of the rare disease, acute yellow atrophy of the liver, the reason for the relatively high female deathrate probably lies in the recognized frequent association of the disease with pregnancy. Pregnancy is also believed by medical authors to be an important factor in causing the high deathrate among women from gallstones.

Diseases of the veins and chronic bronchitis are two other conditions more fatal to women.

Among deaths caused by violence there is only one kind, burns, which is charged with a higher death toll among girls and women. Three out of every five deaths from this cause are those of females.

The predominance of deaths among this sex may suggest to the clinicians and to the laboratory students of these diseases, relations which will serve as a clue for directing further research. Certainly, these sex differences are not clearly explained, in many instances at least, in medical literature. (*Statist. Bull.*, Metropol. Life Ins. Co.), 1924, 5. No. 5.

PHYSICAL DEFECTS AMONG 8,887 UNDERWEIGHT SCHOOL CHILDREN.—*Publ. Health Reports*, April 21, 1922, 945–'6.

"Early in 1922 the medical inspectors of the department of health of Detroit completed the physical inspection of 8,887 school children who were found to be 15 per cent or more underweight. . .This number found to be 15 per cent or more underweight is 7.9 per cent of the school children of Detroit. . .In order to secure uniformity and therefore make records for different schools comparable, the department of health devised a simple plan of designating various degrees of defects, and arranged for the examiners to work in teams of three each. These men examined independently the same groups of children, reporting the effects found in terms of the definite graded scales, and they met at intervals to check up their independent work. One physical defect or more was found among 74.9 per cent of the 8,887 underweight children. No outstanding physical defect was found among 25.1 per cent.

"The number of each of the more important defects per 1,000 children was given as follows: Tonsils—enlarged or infected, 508; defective teeth—227; Anemic—73; Faulty vision—93; Mouth breathing—92; Heart—abnormal (recommended for further more careful examination)—48; Lungs—suspicious (recommended for further more careful examination)—31; Defective hearing—20; Enlarged thyroid—29; Enlarged anterior cervical glands—11; Skin diseases—11; Orthopedic defects—6; Deformed palate—1."

POSTURAL DEFECTS IN COLLEGE MEN. By Cook (Robert J.)—*Am. Physical Educ. Rev.*, 1923, XXVIII, No. 4, 169–172.

"Within the past fifteen years there has gradually risen in America an increasing interest in the correction of postural defects in the American youth." At the Yale University during the last three years 2,200 Freshmen were examined for such defects with the following results: Only 20 per cent of the total were found to have "a normal spine contour, *i. e.* with no increase in the antero-posterior or lateral curvature of the spine, though 38 per cent have a normal antero-posterior and 50 per cent have no lateral curve. As regards round shoulders, but 5.8 per cent are without this defect while nearly 20 per cent fall into the more severely affected groups and are in need of correction to overcome this defect, 38 per cent have a normal anteroposterior curvature of the spine, while 33 per cent show an increase in the anteroposterior curve of such a type that corrective measures are advisable. . .Forty-one per cent have a postural or C scoliosis, that is, lateral curvature to one side, while 8 per cent have a structural or S curve making a total of 49 per cent having scoliosis of which number about 20 per cent are in need of correctional work. Fifty-eight per cent have a flat chest and 50 per cent have a prominent abdomen. Nearly 5 per cent have a short leg, and in 20 per cent the pelvis tilts to one side, usually the left. . .In regard to the feet we have found that only 9.6 per cent have had or have trouble with their feet, though over 65 per cent show some pronation and of these over 6 per cent have excessive pronation. The longitudinal arch is lost in only 0.22 per cent. We find more medium than low arches. A very few have a high arched foot. Two and six-one-hundredths per cent have a short heel cord, limiting dorsiflexion to a right angle or less, and in 11 per cent more the flexibility of the foot is definitely limited.

"To return to the question of round shoulders, this condition occurs both with and without increase in the antero-posterior curve of the spine. Rounding or drooping of the shoulders is much commoner than round back, though it runs somewhat parallel with the increase in the degree of kyphosis. Round shoulders are not found in proportion to the type or severity of the scoliosis, though both may occur together.

"Flatness of the chest and prominence of the abdomen parallel somewhat the degree of rounding of the shoulders, though both conditions run more truly parallel to increase in the antero-posterior spinal curvature.

"Turning to scoliosis we find that 50.78 per cent have no scoliosis, 1.29 per cent have a right postural, and 36.86 per cent have a left postural, while 8.7 per cent have a structural curve. . .

"The above mentioned physical defects are found in all types of men. They are about equally distributed among the athletes of major sports, of minor sports, and among those men who have grown up with little or no attention to any sport."

Most yield readily to corrective measures, but others are overcome with difficulty.

MENTALITY

Impossible to Judge Intelligence From Pictures.—Individuals attempting to judge intelligence from photographs can obtain as accurate results with their eyes closed as with them open is the decision of Dr. Donald A. Laird and Herman Remmers of Colgate University.

Nearly 400 persons were asked to arrange ten or more pictures of persons of measured intelligence. Select the brainiest or most intelligent faces and arrange them in a descending order of intelligence, were the instructions. It was found that women were no better judges of intelligence than the men, but that both men and women had a tendency to rate women a little higher in the scale than men,

Groups of four or five were asked to work together with the same unreliable result. The tests were gone over again by a professional "character reader and vocational expert" and he did no better than the average person in arranging the pictures.

Other conclusions arrived at as a result of the tests were "Older persons have no better abilities in this than do the younger, and the more intelligent persons have no better abilities in this than persons with less intelligence."

"The average-person-at-large still possesses a large modicum of belief in his abilities in 'sizing up' others by appearances," the investigators comment. "The school superintendent demands a picture of the candidates for positions in the public schools. No picture, no job. A picture taken within certain date limits is one of the necessary qualifications for entering the consular service. And so the gauntlet runs from federal to individual in accepting their abilities is in estimating certain characteristics from personal appearance, more especially from photographs." (*The Science News-Letter* January 31, 1925)

A Study of American Intelligence. By Brigham (Carl C.); with Foreword by Robert M. Yerkes.—Princeton University Press, 1923, 210 pp.

This book, notwithstanding the send-off by one of the foremost psychologists of this country, is a good or perhaps it would be better to say striking, example of how imperfect data, especially when flavored with rather marked individual views, may mislead. It would hardly be fair to the author to quote a few of his conclusions, however tempting the opportunity. But what seems eminently fair is to expect of him corroborative scientific evidence on conclusions which if true would demand effective remedies, but if not true or not fully true, should be contradicted lest they be used, as they have already begun to be used, for the furthering intolerance and unwarranted prejudices in this country.

FACTORS IN THE MENTAL HEALTH OF BOYS OF FOREIGN PARENTAGE. By Jarett (Mary C.)—*Pub. Health Rep.*, 1924, XXXIX, No. 17, 863–883.

"The material available for this study does not afford any clear indication of the relation of mental disorder to social maladjustments among the foreignborn. No conclusions can be drawn from the facts obtained in the case records. These are not sufficiently detailed to indicate difficulties experienced by immigrants in adapting themselves to American customs and institutions. There is not sufficient information available to show what role social factors that are peculiar to immigrants play in aggravating latent mental diseases or producing unusual mental strain that may lead to a social conduct.

"The records studied deal chiefly with existing situations and, to some extent, with past situations and conditions in the lives of these families. They do not show the causes of these conditions, which must be sought in the personal characteristics, the thoughts and behavior of the persons concerned, their effect upon one another, and the effects of environmental circumstances upon them. In a certain number of cases in which psychiatric studies of the boys were made, data of this kind had been recorded; but here, too, the foreign element does not appear as a causative factor, and it is impossible to be sure whether there were no such causes of difficulty or whether they were overlooked. . .The importance of mental hygiene in the immigration problem lies not only in the prevention of mental disorder and its resulting social disorder but chiefly in the development of mental health and stability among the foreignborn members of our population."

THE MINDS AND MANNERS OF WILD ANIMALS. By Hornaday (William T.)—8°, N. Y. (Scribner's, $2.50), 1922, 328 pp., 29 illustr's.

A somewhat far cry seemingly to physical anthropology, yet the genuinely entertaining as well as humanely instructive book contains many observations on anthropoid apes that, recorded by a sympathetic and experienced observer such as Mr. Hornaday cannot but be of interest to anthropology; and the same is true of the numerous contrasts between the mentality of lower forms and man pointed out by the author. While perhaps not scientific in the strict sense of the word, the book is good biologic literature, well worth being read by the anthropologist as well as by many others.

VARIATION

PHYSIOLOGICAL

PHYSICAL ABILITY RELATING TO PHYSIOLOGICAL DEVELOPMENT. By Bentzen (Louis) and Carl Schiötz.—Kristiania, 1920, (R. Bentzens Boktrykkeri) 8°, 68 pp., 10 figs. in text, 6 pl.

Valuable observations on the height and weight of a large number of scholars in the higher schools of Kristiania, in their relation to efficiency. By establishing what the authors regard as definite or safe norms "the scholars have been given the means of controlling their own physical ability from a physiological point of view as well as their physique in so far as the relation between weight and height is concerned."

A TEST OF PHYSICAL EFFICIENCY: THE CORRELATION BETWEEN RESULTS THEREFROM AND RESULTS FROM TESTS OF MENTAL EFFICIENCY. By Schwegler (R. A.) and J. L. Engelhardt.—*Am. Phys. Educa. Rev.*, 1924, XXIX, No. 9, 501–505.

"Very little is known concerning the relationship between mental and physical efficiency. . .Prerequisites to an investigation of this nature are first, satisfactory tests of mental efficiency, and second, satisfactory tests of physical efficiency." A physical test intended to meet these needs has been devised and tested by the authors, with the following main results: "The physical test devised for this study has satisfactorily met all requirements for a sound test of physical efficiency. It has a high correlation with the composite judgment of physical instructors; it has a high self-correlation; and it is applicable to adolescent and post-adolescent boys. Since the physical test used herein has stood the test of criteria applied and since the mental tests employed have stood the test as to reliability in the mental field, findings of this study concerning relationship between these two phases of human activity—the mental and physical—should be reliable and significant. Findings of this study offer no evidence of a marked correlation between mental and physical efficiency."

THE EYESIGHT OF THE SCHOOL CHILD AS DETERMINED BY THE SNELLEN TEST. By Collins (Selwyn D.)—*Pub. Health Rep.*, 1924, XXXIX, No. 48, 3013–3026.

"Snellen's eye tests were made of 9,245 children from 6 to 16 years of age in South Carolina, Maryland, Delaware and New York State. Of the children of all ages 63 per cent were found to be normal ($^{10}/_{10}$ or better) in both eyes, 27 per cent moderately defective ($^{6}/_{10}$, $^{7}/_{10}$, or $^{8}/_{10}$ in one eye and $^{6}/_{10}$ or better in the other), and 10 per cent had rather poor vision ($^{5}/_{10}$ or less)in one or both eyes.

The percentage of boys with normal vision in both eyes was slightly greater than the percentage of girls. Conversely, the percentage of girls with moderately defective vision was higher than that of boys but the percentage with poor vision was about the same for the two sexes. The percentage of children with normal vision ($^{10}/_{10}$ or better) in both eyes increased with age. The increase, however, was all in the class with vision better than $^{10}/_{10}$. The percentage of children with moderately defective vision decreased with age, but the percentage with markedly defective vision ($^{3}/_{10}$ or less in one or both eyes) increased markedly with age. About 80 per cent of the children with vision as poor as $^{5}/_{10}$ or less in one or both eyes did not have glasses. The percentage of children who were wearing glasses increased with age."

VARIATION IN EYESIGHT AT DIFFERENT AGES, AS DETERMINED BY THE SNELLEN TEST. By Collins (Selwyn D.) and Rollo H. Britten. *Pub. Health Rep.*, Dec. 1924, XXXIX, No. 51.

"The results of Snellen vision tests of 4,862 native white school boys and 6,479 male white industrial workers were tabulated to show the age incidence throughout life of good and poor vision.

The percentage of persons with normal vision ($^{20}/_{20}$ or better in both eyes) increased with age up to 18 or 19 years, after which it declined. After about 45 years of age the rate of decline was much more rapid.

The percentage of persons with markedly defective vision ($^{20}/_{50}$ or less in one or both eyes) increased steadily after 6 years of age. The rate of increase was more rapid during school ages than in the early ages of industrial life.

The percentage of persons with moderately defective vision declined during school ages, then increased from 20 to 50 years of age, and then declined again."

THE RELATION OF VITAL CAPACITY TO OTHER PHYSICAL MEASUREMENTS IN WOMEN. By Pasmore (Edith E.) & Frank W. Weymouth.—*Am. Phys. Educ. Rev.*, 1924, XXIX, No. 4, 166–175.

"Among the college women examined, the correlation of vital capacity with surface area is higher than the correlation of vital capacity with any other measurement taken. The other correlations in decreasing order of magnitude are: Chest, weight, sitting height, standing height. There is little difference between weight and height. . .The women examined were slightly less variable than college men in all measurements except vital capacity. The ratio of vital capacity to surface area was 2.531 in men and 1.757 in women. Among women, the coefficients of correlation between vital capacity and standing height, weight and surface area are lower than these coefficients of correlation in men."

DIE RESPIRATORISCHE EXKURSIONSBREITE DES BRUSTUMFANGS UND IHRE BEDEUTUNG. By Scheidt (—)—*D. mediz. Wochschr.*, 1922, No. 6; repr. 7 pp.

A contribution of value to the study of the changes in the thorax through in-and expiration. While but little is given of the actual data, the methods as well as results are discussed. The writer reaches the conclusion that the most suitable means for the study of these changes is the thoracic index (based on thoracic breadth and depth) though the circumference may also be employed. The article ends with a good bibliography of the subject.

The Normal Rate of the Pulse in Cantonese Students. By Cadbury (William W.)—*China Med. J.*, March 1922. Repr. 6 pp.

"The average pulse rate per minute of the healthy Cantonese male, resting in the sitting posture, is as follows: For ages 7–10 years, 88.7; 11 to 15 years, 83.8; 16 to 20 years, 81.6; 21 to 25 years, 75.6.

These rates are above those recorded for males of the same ages in temperate climates, and approximate the average rates recorded for white and Filipino males living in the Philippine Islands.

The Blood Pressure of Normal Cantonese Students. By Cadbury (W. W.)—*Arch. Internal Med.*, 1922, XXX, 362–377.

"A study of the blood pressure of 774 healthy, male Cantonese youths shows that their average systolic, diastolic and, to a less degree, pulse pressures, are lower than the standards for European and American youth of corresponding age, weight or height."

Lefthandedness, by Parson (Beaufort Sims): 8°, 1924 (Macmillan), 185 pp., 10 diagrams; bibliography of 600 items; foreword by Dr. H. E. Jordan.

The title of this interesting pronouncement on a much controverted subject seems somewhat too restricted; perhaps a better title would have been "The Rationale of Handedness," since the real thesis is the broad one of bilateral manual asymmetry. The author's announced purpose is "to review in outline the principal ideas already advanced, and to follow this by presenting in concise form a theory and demonstration that seem conclusively to account for all the various phenomena involved." He makes out a strong case for "unilateral sighting," a "necessary adjunct of binocular vision," as the true cause of asymmetrical manual function, and lends additional weight to his work by experimental verification of the main contention. These experiments, chiefly among schoolchildren, were made with the manuscope, a novel testing device which determines ocular dextrality or sinistrality, and hence (according to the theory) native handedness. Aside from its original concepts in the domain of vision, the work presents other ideas of apparent value to physical anthropology. For instance, the prevalence of native sinistrality is shown to be much greater than hitherto suspected, thus furnishing what is alleged to be a sounder basis for the Mendelian expectation. There is also suggested a new and plausible theory of mirror-writing. Ambidexterity takes on a different biological meaning and assumes evolutionary significance.

It is well to note that the author takes the entire problem of handedness out of the realm of psychology and solves it by the application of purely physiological principles. His work seems destined to stimulate further research and experimentation. The bibliography is excellent.

B. S. P.

THE MENARCHE IN DUTCH WOMEN AND ITS PRECIPITATED APPEARANCE IN THE YOUNGEST GENERATION. By Bolk (L.)—*Proc. Kon. Ak. Wetensch.*, Amsterdam, XXVI, Nos. 7 & 8, 650–663.

With the aid of medical men the author collected "a number of data with regard to the menarche in Dutch women, about which nothing was known so far." Attention was also given to the influence of pigmentation on the appearance of the function. The data extend to 1800 non-Jewish women and 165 Jewesses.

In the non-Jewish, the time of the setting in of menstruation varied "between the tenth and eighteenth year; it is true that in four cases the menses already appeared before the tenth year (8 yrs. 2 m.; 8 y. 12m.; 9 y. 4m.; and 9 y. 12m.), but these cases do not join regularly on to the variability-curve and may be regarded as abnormal preccocity." A large majority of the cases (65 per cent) occurred from the twelfth to the fourteenth year, the average being 13 years 9½ months. "The material was sorted and divided into the women with light and those with dark eyes; these will in future be called "blondes" and "brunettes"; of the former the material contained 1130, of the latter 670." The results show that, in the Dutch it is the fairer type which reaches on the average a somewhat earlier maturity (lighter type average 13 y. 5 m. 17 days; darker 14 y. 4 m. 5 days). "As we have to do here with two groups of people living in the same circumstances, which excludes external factors which might influence the menarche, this difference must be entirely regarded as the result of an internal factor, and it is only the racial factor which can be taken into consideration here. The light-eyed component of our population belongs, in general, to the race which peoples the North of Europe, the *Homo nordicus* while the brown-eyed as is proved by a former investigation of mine, belongs to the race inhabiting the centre of Europe the *Homo alpinus*."

A second noteworthy result is "that the menarche in what we may call the youngest generation, as regards sexual maturity, arrives at a considerably earlier period than formerly. . .The mean age of the first menstruation in the persons born before 1880 is 15 yrs. 3 m. and 20 days." Taking mothers and daughters, the average age of the menarche of the former was 14 y. 9 m. 25 days, of the latter 13 y. 7 m. 1 day.

"These results undeniably prove the considerable precipitation of the function of the sexual glands during the last decades; for although the figures of this earlier appearance of the menstruation may vary a little, one can fix the average at about 14 months." The earlier appearance of the menarche must be looked upon as the expression of a hastened process in development.

As to causes the author is inclined to give most importance to the external stimuli of modern life.

As to Jewesses "as far as the threshold-age of maturity is concerned there is no difference between the Jewish and the non-Jewish girls. And yet there is a difference, *viz.* the greater frequency of the menarche immediately after the threshold has been crossed, so that before the age of 12 the sexual function has begun in forty per cent of the Jewish girls compared to thirty per cent in the non-Jewish blondes and eighteen per cent in the brunettes." The average for the Jewish girls was 13 y. 3 m. 24 days. "The averred prococity of the Jewish girls compared with the rest of the population, seems, therefore, not to exist for the slight difference which can be discerned by the above methods is sufficiently explained by the fact that the data of the Jewesses, with the exception of a few, refer to inhabitants of towns."

THE RELATION BETWEEN BREAST AND ARTIFICIAL FEEDING AND INFANT MORTALITY. By Woodbury (Robert M.)—*Am. J. Hygiene*, 1922, II, No. 6, 668–687.

The study "has shown that artificial feeding, as actually practised in typical city populations, is associated with a mortality between three and four times as high as the mortality among breast-fed infants. This excess mortality is not to be explained either by the slight overweighting of the group of artificially fed with infants in certain groups characterized by high mortality rates; and it appears in all nationality and in all earnings groups, though with variations depending probably upon the particular conditions prevailing in the groups."

CAUSES OF DEFECTIVE CHILDREN. By Schlapp (Max G.)—*J. Heredity*, XIV, 1923, No. 9, 387–397.

"Recent studies of mentally defective children and their mothers have served to emphasize the fact that prenatal pathological conditions in the female parent are responsible for certain definite malformations in the child. These investigations have thrown light upon the causation of many obscure defects and deformities. More specifically they have proved, for the first time, that to certain chemical imbalance in the blood of the mother can be traced the cause of many of the strange, monstrous unfortunates who have been born into the world and of whose peculiarities history has defied any explanation outside the realm of superstition. The certainty that many of them, notably the cretins, can be normalized after birth must be welcomed as an addition of the first rank to the sum of our medical and social progress."

TUBERCULOSIS AND FERTILITY. By Kacprzak (Martin)—*Am. J. Hygiene*, 1924, IV, No. 6, 605–638.

"Any kind of tuberculous mating gives a smaller total absolute number of pregnancies than a non-tuberculosis, *i. e.*, on the whole, tuberculous parents add less to the bulk of the population than if they were unaffected with the disease. Tuberculosis of the mother has a greater influence on the mean number of pregnancies than tuberculosis in the father, statistically considered. The lower absolute number of offspring, per completed tuberculous family, as compared with the non-tuberculous is largely due to early death of the tuberculous; slightly to a greater number of abortions and miscarriages in the tuberculous. The fertility of marriage is enhanced by tuberculosis of either one of the consorts.

The mating of a tuberculous male with a non-tuberculous female shows an increased fertility at all age groups, and in almost all combinations of different age groups of male and female. The tuberculous women married with non-tuberculous men show a higher fertility than the non-tuberculous in all age groups, if the age of the husband at death is not taken into consideration. When the age of both parents is considered in a few instances, the tuberculous women that die under 40 are less prolific than the non-tuberculous. This is probably due to the rapid course of the disease, substantially accelerated by childbearing. The mating of both parents tuberculous seems to show a higher fertility than the mating of both non-tuberculous. This is more apparent in the consorts who completed their married life before 40."

THE MONGOL IN OUR MIDST. By Crookshank (F. G.)—N. Y., 1924, 12 mo, 123 pp., 29 pl. (E. P. Dutton & Co., $1.50).

Perhaps the best and sufficient comment on this misguided little book is its advertisement on the front cover. It says: "The author, a very well-known and successful English hospital doctor of unusually varied experience, here brings forward an astonishing mass of evidence in favor of a threefold origin of the human race. Whether we think of them as White, Black or Yellow, or, symbolically, as the three sons of Noah, there are, according to Dr. Crookshank, three irreducible stocks corresponding to the three types of Great Ape, the Chimpanzee, the Gorilla and the Orang. Incidentally new light is thrown on the "Scientific Basis" of Palmistry, the Posture of Buddha, and the causes of "Mongolian Imbecility'."

Little wonder that the author is obliged to complain that his observations "although susceptible of prompt verification by any intelligent person who cares to look around him, have been gently though firmly put out of court by those to whom they have been introduced, on the excellent ground that they appear to involve conclusions highly inconvenient to orthodox medical and scientific dogmatists." However the author may have one consolation: the subject is so "catchy" that he will doubtless be followed.

MICROCEPHALIC PEOPLE SOMETIMES CALLED "PIN HEADS." By Bernstein (Chas.)—*J. Hered.*, 1922, XIII, No. 1, 30–39.

In this family five of the ten children were microcephalics of a pronounced type when the father and mother were both of good physical type and mental ability. The whole family factor reflecting degeneracy so far as could be found out was alcoholism.

THE DEVIATION OF IDIOT BOYS FROM NORMAL BOYS IN BODILY PROPORTIONS. By Davenport (Chas. E.) and Bertha E. Martin.—*Proc. XLVII Sess. Am. Ass. Study Feeble-Minded*, Detroit, 1923, repr. 8 pp.

"Idiot boys, as compared with normals, are retarded in their physical development during their early years, and their proportions even more strikingly than their size tend to remain at those of the adolescent stage; just as their mental development is retarded and stopped at a still earlier age, say of about 8 years. Apparently the same causes that interfere with mental development interfere, likewise, with physical development; or, better, the failure of development affects skeleton, muscles and nervous system alike."

A Case of Polydactylia Showing Certain Atavistic Characters. By Smith (Sydney) and Boris Boulgakoff—*J. Anat.*, 1924, LVIII, Part 4, 359–367.

The right foot (left amputated and no knowledge of it) of an adult male Egyptian who died recently, with a remarkable simian aspect, together with a supernumary (second) digit. The shortness of the toes with the long abstanding thumb-like great toe look very striking. The feet of the brothers and sisters of the subject are reported normal. There are numerous interesting details as to the soft parts and the bones.

Nouveau cas d'octodactylie. By de Lima (Pirès) and L. Dubreuil-Chambardel—*Bull. & Mem. Soc. Anthrop.*, Paris, 1920, n. s. I, 171–174.

For several years M. de Lima has devoted himself to a study of the anomalies of limbs in the Portugese, and has already found 66 cases of polydactyly. This is more frequent (58.5 per cent of the 66 cases) among males than among females and more frequent (58 per cent) on the hands than on the feet. In 13 individuals the anomaly was on both hands and both feet; in 3 on both feet and one hand, and in 1 on both hands and 1 foot.

The most common supernumerary digit is the "prepollex" (28 instances, 37.3 per cent). In 22 instances the supplementary digit was attached to the ulnar border of the hand, in 18 to the external border of the fifth toe. There were 5 cases of prehallux, and 2 in which the extra digit was between the 4th and 5th toe.

Among the 66 cases of polydactyly there was one case of a probably bifid foot in a black infant, and 3 cases of octodactyly. The latter are briefly described.

Sur deux cas d'albinisme en Indo-Chine. By Bonifacy—*Bull. & Mém. Soc. d'Anthrop.* Paris, 1920; Sér. 7, Nos. 4–6, 134–135.

Speaks of discolorations of hair due to sun, elements, ill health in infants, with occasional fair red hair in the scanty beard among the Annamites (Tonkin), and reports two full albinos (one Tonkinese, one Lolo) from that country; mentions also three albinos among the 12 or 13 mixed-blood children of a Tonkin Jew.

DEMOGRAPHY

A Brief Summary of the Vital Statistics of the U. S. Army During the World War. By Love (Albert G.)—repr. fr. *The Milit. Surgeon*, Aug. 1922, 8°, 30 pp.

An uncommonly clear analysis of the morbidity and mortality in the U. S. Army during the World War, with causation and racial comparison (Whites, Negroes, Filippinos, Porto-Ricans, Hawaiians). "The total number of men who were in the United States Army (excluding the U. S. Navy and Marines) during the World War, from April 1, 1917 to December 31, 1919, inclusive, amounted to 4,122,930. . . The total number of deaths in the United States Army personnel that occurred during the War period amounted to 114,109. Of this number 58,119, or 50.93 per cent, occurred as the result of disease; 5,591 or 4.90 per cent, as the result of ordinary injuries; 13,705, or 12.01 per cent as the result of wounds received in action (including those in Russia and Siberia); and 36,694, or 32.16 per cent were killed in action. Influenza was the leading cause of deaths from disease for the total Army. This disease alone accounted for 24,664 deaths, or 42.44 per cent of the total from disease; lobar pneumonia and bronchopneumonia stood second and third with a total of 19,167 deaths or 32.97 per cent of the total. Including the common respiratory diseases, the total number of deaths from the respiratory group amounted to 45,037, or 77.49 per cent of the total. Of individual diseases measles stood number 4, with 2,370 deaths, or 4.08 per cent of the total; tuberculosis of the lungs fifth, with 2,240 deaths, or 3.85 per cent of the total; and cerebrospinal meningitis sixth, with 1,836 deaths, or 3.16 per cent of the total."

Of diseases, diptheria and scarlet fever were most frequent in the whites; respiratory affections, measles and malaria in the Porto-Ricans; tuberculosis in the Hawaiians, Filipinos and Negroes; mumps, cerebrospinal meningitis and venereal diseases in the Negroes.

INCREASE OF POPULATION IN THE UNITED STATES 1910–1920. By Rossiter (William S.)—*Census Monographs*, I, Wash., 1922, Imp. 8°, 255 pp.

The results of the XIV Census show "war influence at each successive step of the analysis which appears in this volume: In reduction in the rate of national population increase; in the changes which occurred in states, counties, cities and smaller communities; and finally, in the pronounced readjustments which took place among the different elements of the population. The persistent influence of the war alone is likely to make the Fourteenth Census conspicuous among Federal censuses, even long after it has passed into history. There are, however, two other causes for prominence. If succeeding censuses show a return to a more liberal percentage of increase, the census of 1920 will be noteworthy for the sharp depression which it showed in population growth. On the other hand, should the low rate of increase continue, or should the rate tend to decline still further, then the Fourteenth Census will prove to be noteworthy as marking the beginning of a distinct slowing down in national growth. Finally, the Fourteenth Census records the effect (caused directly by the war) of an unsettlement of family relations probably more widespread than corresponding changes during any previous decade covered by American census-taking except that of the Civil War. Millions of able-bodied men, a considerable proportion married, repaired for longer or shorter periods to centers of industrial activity or went to training camps or abroad with the colors. The degree of this suspension of family relations cannot be measured, because by 1920 many persons had returned to their previous places of residence and were there enumerated as though never absent. The number thus long absent but having returned must have been great, yet in spite of this partial readjustment the census everywhere gives evidence of an unusual proportion of changes in residence. This characteristic of the decade in the aggregate must have been an important factor in retarding population increase.

"From 1910 to 1920 the population of the United States increased 14,000,000, a considerably smaller absolute number than that shown by the census of 1910, but larger than the increase shown at any previous census. This increase was contributed unequally. A dozen states were responsible for nearly two-thirds of it and at the opposite extreme 3 states returned a decrease and 9 other states an increase of about 400,000. As might be expected, in view of war influences, the increase of population in the United States from 1910 to 1920 was largely confined to the industrial states, and within those states to areas principally urban. For the first time in the history of the nation persons residing in urban environments exceeded in number those living in rural communities. The former increased at a rapid rate, approximating 25 per cent; but the increase of the latter was much slower—a rate little more, indeed, than 5 per cent. . .This noteworthy change was emphasized even more strongly by the counties. There are over 3,000 counties in the United States. Of this number, one-third declined in population. The declining counties comprised over 900,000 square miles, or almost one-third of the area of the United States, and contained 19,000,000 people, or more than one-sixth of the entire population. The counties which decreased were largely rural, and thus sharply reflected the tendency of the decade and the effort of large numbers of persons to readjust themselves to greater advantage during the period of immense industrial and agricultural activity.

In New York—which, possessing a greater population than any other state in the Union, affords an important example of extreme urban increase with contrasting conditions in the rural communities—New York City, with more than half the entire population, showed 17.9 per cent increase, as compared with 9.6 per cent for the remainder of the state. The latter increase in turn was practically all contributed by 21 cities of 25,000 or more. Three-fourths, indeed, of the 1,000 minor civil divisions of the State of New York lost population during the decade.

"When the increase of population at the Fourteenth Census is considered by nativity and color it appears that the whites increased by more than 13,000,000 and the Negroes by less than 700,000. The white increase was thus 16 per cent and the Negro but 6.5 per cent, marked decreases in the percentages for both elements. . .The percentage of increase in the number of Negroes was much less than that shown at any previous census. . .As in the past (since 1810), this increase was derived almost exclusively from births. . .The increase in foreign-born shown at the Fourteenth Census was extremely small." The direct or indirect influence of the war is apparent throughout the results of this census. "In total population, in the readjustment of the native white population, in the decreased proportion of foreigners, and in the greatly reduced increase and the readjustments of the Negro population, the economic conditions which controlled the decade are clearly evident."

LIFE TABLES FOR THE POPULATION OF NEW YORK STATE ACCORDING TO NATIVITY. By DePorte (J. V.)—*Am. J. Hygiene*, 1924, IV, No. 4, 302–326.

"Life tables for white males, twenty years and over, of the three large divisions of population of the state of New York: native-born of native parentage, native-born of foreign or mixed parentage, and foreign-born, based on the average number of deaths in the years 1909, 1910, 1911, as given in the U. S. Mortality Reports, and the population, as given in the U. S. Census Report, 1910, show that (a) The death rates of native-born white males of native parentage had been lower, and the expectation of life higher than of either the mixed or foreign group, at practically every year of the life span. (b) The death rates of foreign-born white males had been lower than those of the mixed group, from the twentieth to the fifty-eighth year, and from the seventy-fifth year on. Between the ages fifty-eight and seventy-five, the death rates of the mixed group had been lower than those of the foreign group. The expectation of life is, of course, in inverse relation to the death rates. (c) One-half of the original number, 100,000, of white males, among native-born of native parentage, reach the seventieth year, among native-born of mixed or foreign parentage—the sixty-first year, among foreign-born—the sixty-third year.

The death rates of native-born white males of native parentage had been lower than those of the mixed and foreign group also in the years 1900 and 1920. The death rates of native-born white males of mixed parentage have been higher than those of the foreign-born, in 1900 for all age groups through the forty-ninth year, in 1920 for all age-groups through the ninety-fourth year. The death rates of white females, with certain few exceptions, parallel those among males. The racial composition of the mixed group is largely English-Scotch-Welsh-German-Irish; the foreign-born, particularly in early age periods, contain large accessions of Austrians, Italians, Poles and Russians. Mixed marriages have, in the majority of cases, been unions between foreign-born and native-born of the same racial stock. Reasons for more favorable conditions among foreign-born, as compared with the native-born of foreign and mixed parentage: (a) Natural selection. Immigrants are usually above the physical average in their homelands. (b) Artificial selection. Restrictive legislation of 1882 and 1893 barred physical and mental defectives, convicts and paupers from entering the country. Both natural and artificial selection operated in favor of a sounder body of foreign-born. (c) Occupational differences. Foreign-born in general, enter less desirable employment where chances of sickness or death from accidents are higher than in occupations of the native-born. The influence of occupational differences offsets in a measure the efforts of selection. (d) The main reason in our opinion, is the unwise social pressure toward superficial Americanization as a result of which a large fraction of the native-born of foreign parentage become strangers to their parents, grow up without home influences, forsaking the culture and traditions of their people, and finding nothing in the life of the street to take their place. The reason cannot be the biological weakness of a blend, since the native-born of the first generation are in most cases products of the same racial strain. This opinion finds support in the fact that in Minnesota, where the population is still largely rural, where the foreign-born and the nativeborn have been from the beginning of settlement of the same Teutonic stock—English, German, Scandinavian, where the neighbors of a native-born person were very likely people of the same or similar strain and of comparatively recent origin, where the old-home traditions of the peoples had not been held in contempt, and where therefore Americanization was a process of addition, and not of total rejection of everything "foreign"—in Minnesota in 1910 and 1920, the relation between the death rates of native-born of the first generation and of foreign-born, had been the reverse of what we found it to be in New York."

THE FREQUENCIES OF SEX COMBINATIONS IN HUMAN FAMILIES. By Parkes (A. S.)—*Eug. Rev.*, 1924m XVI, No. 3, 211–216.

In a previous paper in this JOURNAL the author gave "some data collected from the Peerage relating to the variation in sex-ratio in different sizes of families. These data showed that whereas small families had a very large excess of males, large families had only a normal excess, or actually an excess of females, and it was suggested that the explanation of this fact had a social rather than a physiological basis." In this article the data, analysed further, show that the "original result founded on the crude sex-ratios is correct, and that as the families stand, small families have a tendency to high masculinity and large families a tendency towards femininity. If this result were only ill-marked it is not improbable that a physiological explanation could be found, but since the tendencies are so pronounced it is most probable that some such social factor as was discussed in the previous paper is at work.

THE RACIAL ORIGIN OF ALMSHOUSE PAUPERS IN THE UNITED STATES. By Pearl (Raymond)—*Science*, 1924, LX, No. 1557, 394–497.

"With a few trifling exceptions, all the countries from which the present law *encourages* immigration contributed to almshouse pauperism in 1923 in *excess* of their representation in the population in 1920. On the other hand, again with a few trifling exceptions, those countries from which the present immigration law was specially framed to *discourage* immigration appear in the lower part of the diagram, because they contribute a *smaller* proportion to almshouse pauperism in 1923 than their representation in the general population in 1920. Immigration from five countries in particular, Austria, Mexico, Poland, Russia and Italy, has been subjected to much criticism. It is interesting to note that the immigrants from each of these five countries contributed proportionately *less* to our almshouse pauperism in 1923 than any other group of foreign-born people in the country."

SOME PROBLEMS OF LIFE EXTENSION. By Dublin (Louis I.)—Read bef. Am. Medic. Ass., Chicago, June, 1924, 23 pp., 30 charts.

"The nation-wide acceptance of periodical medical examination offers an excellent opportunity for diminishing the mortality of middle life. . . Some results of periodical health examination will be of interest. Among 17,000 adult white males recently examined, some 13 per cent were found to be overweight by more than 20 per cent above the usual standards for height and age. "Heavy dentistry" with suspected focal infection was found in 42 per cent of the cases!. . .What a budget of future trouble could be avoided for this group if it were possible to correct these defects alone!. . .Most of these persons were apprised of these defects for the first time at these examinations." In actual practice periodical health examination has already shown its great value.

THE INFLUENCE OF ALCOHOL ON THE DURATION OF LIFE. By Pearl (Raymond)—*Proc. Nat. Acad. Sc.*, 1924, X, No. 6, 231–237.

The material on which this study is based "consists of records of certain pertinent data in the life histories of many thousands [over 6,000] of persons [Whites] belonging to the working class population of Baltimore. These records were collected by trained eugenic field workers who visited the families and by long-continued and patient investigation got the facts with a high degree of accuracy." The main results are: "Male persons in the "all heavy" class have a markedly *lower* expectation of life at all ages from 30 to 100 inclusive than do male persons in the "all moderate" class; and a markedly *lower* expectation of life than persons in the "abstainer" class up to and including age 60. From age 60 on the expectation of life is somewhat though not greatly higher in the "all heavy" class than in the "abstainer" class. This result is believed to be possibly due to a selective effect of the very high mortality in the heavy drinking group prior to age 60. In the case of the females the expectation of life is markedly *lower* for the persons in the "all heavy" group than for persons in either the "abstainer" or the "all moderate" group, at all ages from 30 to 100 inclusive.

The "moderate steady" class which is from certain points of view the most important one, shows consistently the *highest* expectation of life at all ages from 30 to 100 inclusive in the case of the females; and also in the males, except that after 70 the "all moderate" male group has very slightly higher expectations than the "moderate steady" male group.

These conclusions are drawn from what is believed to be demonstrably the most critically adequate material, considering both quality and quantity, which has ever been available for the study of the problem of the influence of alcohol upon the duration of human life.

THE LIFE-SPAN OF INSURED WAGE-EARNERS IN 1923. Among the industrial populations of the United States and Canada in 1923 the average after-lifespan, or expectation of life, was 54.55 years at birth. This was a gain of nearly eight years over the expectation shown for the two years 1911–1912 combined, but a loss of about one-half year from the figures computed for 1922 and 1921. It should be remembered, however, that the mortality experience for 1921 was the lowest and the expectation of life the highest ever recorded for this group of the American and Canadian populations. The rise in the deathrates for 1923 was slight and is being overcome by the favorable experience which has prevailed during the first seven months of 1924. We expect accordingly a substantial gain in the 1924 figures on the expectation of life for wage-working populations of the two countries.

For purposes of comparing the several color and sex groups among these insured wage-earners and their families we have prepared figures for the average life-span at age 10. (*Statist. Bull.*, *Met. Life Ins. Co.*, 1924, V, No. 8, 4–6.)

NINETEEN TWENTY-FOUR THE BEST HEALTH YEAR. The health of the people of the United States and Canada was, in all probability, better in 1924 than ever before. This is the first year in which every important cause of death has registered a decrease from the year before.

This is indicated by the year's amazingly low mortality record for approximately sixteen million people—the Industrial policyholders of the Metropolitan Life Insurance Company—who constitute approximately one-seventh of the combined population of the two countries. Their deathrate was 8.5 per 1,000 which was 5.2 per cent better than the year before. In past years, the mortality experience of this large cross-section has proved the best index of what has occurred in the general population, the mortality statistics for which do not become available until months after the insurance figures are at hand. (*Statist. Bull. Met. Life Ins. Co.*, 1925, VI, No. 1).

THE MORTALITY EXPERIENCE OF INDUSTRIAL POLICYHOLDERS. Published by the Industrial Life Insurance Companies, 8°, N. Y., 1923, 150 pp.

A demographic document of much value, showing the causes of death and death rates for the years 1916 to 1920, in the Intercompany Industrial Experience and the U. S. Registration Area.

SUICIDE AND ITS RELATION TO CLIMATIC AND OTHER FACTORS. By Miner (John Rice)— Repr. fr. *Am. J. Hyg.*, 1922, (Monographic ser. No. 2, 8°, 140 pp.)

"The general trend of suicide rates has been upward during the past century, but the higher rates especially tend to become stabilized. A factor in the upward trend is found in the decay of the group spirit. The European war has produced a sharp decline. The trend of suicide is in the opposite direction to the general death rate. Germany, France, Denmark and Sweden show high suicide rates; the British Isles, Norway, Netherlands, and south and east of Europe show low rates. These differences persist in the United States among immigrants, whose suicide rate is however much higher than that of home country. Japan and China have high rates, India low. In the United States, rates are lowest in south, highest in west. The maximum frequency of suicide occurs in May or June, the minimum in December or January. This appears to be an effect of weather *per se*. The lowest suicide rates are shown by the Greek church, followed by Roman Catholics and Protestants. Jewish rates have increased rapidly. Urban suicide rates are higher than rural. Suicide is more frequent among males in occidental countries but among females in India. The suicide rate increases in general with age, but with diminishing velocity. The female rate comes nearest to the male in adolescence. In general the married show lower suicide rates than the single or widowed. The divorced have high rates. Parents show lower rates than the childless. Suicide rates are low among farmers and others employed in steady manual labor in the open air, while the professions (except the clergy and teachers) officials, capitalists, soldiers, innkeepers and migratory laborers show high rates. Low economic status, when stable, is associated in general with low suicide rates. In western Europe mental disease is the most frequent motive of suicide. Both mental and physical diseases are increasing in importance as motives."

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RELATION OF THE SIZE OF THE HEAD AND SKULL TO CAPACITY IN THE TWO SEXES

ALEŠ HRDLIČKA

In working out the relations of the external dimensions of the head and skull with the cranial capacity in the two sexes, the writer has steadily come across an interesting condition which, while known of, so far as he has been able to find seems not to have been accentuated enough previously.

Numerous efforts have been made in anthropometry to obtain some serviceable formula for the expression from external measurements of the capacity of the skull or size of the brain. The contributions on this subject by Manouvrier, Beddoe, Blakeman, Lee, Pearson, Anderson, and Todd[1] are especially well known and all recommend certain formulae or procedures for the above purpose. These formulae, it was recognized from the beginning, could not be the same for the two sexes, but the sex differences do not appear to have been sufficiently determined.

In the writer's work, particularly in the preparation of the "Catalogue of Crania in the U. S. National Museum," he was repeatedly struck with the fact that the external dimensions of the head or skull in the two sexes have never on the average the same relation to the skull capacity,[2] though there are some individual exceptions.

There are two ways of obtaining an expression of the external size of the head or skull. The first is through the maximum circumference of the vault. This measurement is fairly satisfactory on the skulls, though occasionally interfered with by an unusual development of the occipital crest or inion; but in the living serious difficulties are encountered, particularly in the females, on account of the hair.

The second method is by the cranial or head module (*modulus*) or mean diameter. The module is the mean of the standard length, breadth

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[1] For exhaustive bibliography of the subject see Todd (T. Wingate)—Cranial Capacity and Linear Dimensions in White and Negro. *Am. J. Phys. Anthrop.*, 1923, VI, 192.

[2] Obtained by method given in author's "Anthropometry," 8°, Wistar Inst., Phila., 1920.

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and height of the head or skull. It is not quite the same thing in these two, for the height is generally taken from a different basic line or point; but this is of no consequence in the present connection.

The cranial module expressed in four figures (to the second decimal) in males is frequently remarkably close to the cranial capacity expressed in cubic centimeters. The actual relations of the figures in the males of different ethnic groups so far tested range from 98.5–107 to 100; in other words in males the skull capacity equals 98.5 to 107 per cent of the mean skull diameter in four figures (two decimals). But in the females the capacity equals only between 87 and 94.5 per cent of the figure of the mean skull diameter. This means that relatively to the mean skull or head diameter the female brain is in average about 7 per cent smaller than that of the male. In a male with mean skull diameter of 15.50 cm. the cranial capacity is close to 1550 cc., in a female with mean skull diameter of 14.80 cm. the capacity will be approximately 1360 cc. and may be lower. The female brain is less fully developed than that of the male in the basal and other parts which are not shown in the three main skull dimensions from which the mean diameter is derived, but have an effect on the capacity.

A small series of illustrations of the actual conditions obtained in various crania, will make this point sufficiently clear.

	Male			Female		
Tribe	Cephalic Module	Capacity	Ratio	Cephalic Module	Capacity	Ratio
Algonquin............	(97) 15.46	(97) 1524	*92.10*	(94) 14.59	(94) 1303	*89.37*
Shoshonean...........	(171) 15.19	(171) 1415	*93.13*	(181) 14.51	(181) 1269	*87.45*
Siouan...............	(136) 15.24	(136) 1451	*95.21*	(101) 14.70	(101) 1324	*90.06*
Caddoan..............	(5) 15.11	(5) 1405	*92.98*	(6) 14.33	(6) 1281	*87.09*
Eskimo...............	(211) 15.44	(211) 1507	*97.60*	(131) 14.92	(131) 1381	*92.56*
Alaskan..............	(58) 15.39	(58) 1539	*100.–*	(44) 14.98	(44) 1333	*88.98*
Mongols..............	(129) 15.39	(129) 1645	*106.88*	(87) 14.66	(87) 1393	*94.33*

On the basis of these and other data it is safe to conclude that the external measurements of either the skull or the head do not bear the same relation to the internal capacity of the same skulls and heads in the two sexes and that the differences they show are of considerable importance. The average relations of the external and internal head or skull dimensions of each sex remain to be established. There appear in addition to the main point curious group differences.

THE ESTIMATION OF CRANIAL CAPACITY

A Comparison of the Direct Water and Seed Methods

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INTRODUCTION

In every collection of skulls it is important to have determinations of cranial capacity. If the skulls are dried macerated specimens the determinations must be carried by some modification of the seed method. As a matter of fact shot or glass perles or some other seed substitute may be employed but the essential technique is the same. In our collection we are fortunate to obtain the skulls fresh from the cadavera and in the majority of our specimens we can therefore measure capacity by the water method. Nevertheless there are many which, for some reason or another, do not permit of this method of determination. For these we must either compute capacity by the indirect mathematical method or determine it directly by seed. In a former paper the mathematical procedure has been fully set forth (5) but it is apparent that we must have some knowledge of the comparative value of the seed method in order to complete our information.

Further introduction is unnecessary. For details the reader is referred to the paper already mentioned. The grain used in our seed determinations is white mustard seed and the technique is that described by Hrdlička (2). For the comparison we shall take forty-six male White crania of which the capacity has already been measured by the water method. These skulls have been fully dried in the laboratory before being submitted to the seed technique. It is to be understood that all skulls have been split in the median sagittal plane and the two halves are pinned and clipped together. For the seed technique we take the additional precaution to stuff the orbits with absorbent cotton and to bind together the two halves still more effectually with a thick rubber band horizontally round the cranium. The final estimate of capacity by the seed method is always the average of three determinations.

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INITIAL EXPERIMENTS

As Miss Kuenzel undertook the seed technique it was imperative to check her results against mine and to make sundry other preliminary observations upon individual and technical differences.

By Hrdlička's method the second half of the technique, namely that of pouring the seed into a graduated 2000 cc. cylinder, is rendered automatic. For this part of the procedure a Hrdlička's funnel was made in Washington under Doctor Hrdlička's direction and sent to us. We have meticulously followed all Hrdlička's directions as published in his most recent account (2).

For filling the cranium we have also adhered rigorously to Hrdlička's technique but as nothing is there stated about the precise method of filling the cranium we have experimented with funnels of different calibre. Table I gives the results obtained on filling two skulls through different funnels. The terminal calibre of the metal funnel is 14 mm. and that of the glass funnel is 8 mm. This experiment was made by myself and each time the seed was emptied through the same metal funnel into a tested graduated 2000 cc. cylinder. As a result it would seem that a slight modification of the method of filling the cranium may give a difference in average determination of somewhat less than 40 cc.

Table I. Influence of Diameter of Filling Funnel upon Record of Capacity.
(14-mm. funnel used in emptying).

Skull	8-mm. funnel			Average	14-mm. funnel			Average
920	1440	1450	1430	1440	1420	1390	1400	1403
924	1510	1530	1510	1517	1520	1480	1530	1510

Following upon this result we decided to make a similar slight difference in the emptying of the cranium. Table II shows the effect of using for the emptying, first the metal funnel already mentioned, and secondly Hrdlička's special technique. A difference of some 30 cc. may ensue. It should be understood that the same volume of seed was poured first through the metal funnel and next through Hrdlička's special funnel. It is apparent from comparison of the figures for the several determinations that slight differences in actual pouring of the seed, differences beyond our control, account for some variation in the total amount registered. For example, in the second determination upon skull 920

Table II. Influence of Emptying Funnel upon Record of Capacity
(8-mm. funnel used in filling).

Skull	14-mm. metal funnel			Average	20-mm. Hrdlicka's funnel			Average
920	1440	1450	1430	1440	1470	1460	1480	1470
924	1510	1530	1510	1517	1520	1560	1550	1543
953	1270	1250	1240	1253	1280	1280	1270	1276

the volume of seed registered by the simple metal funnel method of emptying is 1450 cc. and the same volume of seed registers 1460 cc. by Hrdlička's technique. In the third determination the volume registered by the metal funnel is only 1430 cc.; and this volume becomes, not 1440 cc. by Hrdlička's technique, but 1480 cc. I am perfectly prepared to concede that in general, greater consistency of result is probably given by Hrdlička's method. Indeed it was with a view to eliminating, so far as possible, errors of this nature, that Hrdlička's funnel was constructed. I merely desire to draw attention to the exceedingly delicate nature of the registration and the ease with which the record may be altered.

In our definitive work we have employed the 8-mm. bore glass funnel for filling the cranium and Hrdlička's 20-mm. funnel and cylinder for emptying, taking the utmost care to follow Hrdlička's directions in every particular. It was essential to check Miss Kuenzel's figures against mine.

TABLE IIIA. INFLUENCE OF OBSERVER AND INTANGIBLE CIRCUMSTANCE UPON RECORD OF CAPACITY

(8-mm. filling funnel; 20-mm. Hrdlička's emptying funnel).

Skull	W. M. K. I.			Average	W. M. K. II.			Average	T. W. T.			Average
920	1470	1460	1460	1463	1450	1440	1440	1443	1470	1460	1480	1470
924	1570	1560	1580	1570	1600	1590	1590	1593	1520	1560	1560	1547
953	1270	1280	1300	1283	1300	1300	1320	1307	1280	1280	1270	1276

TABLE IIIB.

Skull	W. M. K.	T. W. T.
909	1600	1613
910	1403	1393
917	1540	1540
919	1306	1310
920	1460	1470
921	1380	1380
922	1480	1480
923	1600	1597
924	1570	1547
953	1283	1276
Average	1459.5	1460.6

Table III gives the results of my estimations upon ten skulls together with Miss Kuenzel's observations and check observations. Each of these three sets of determinations was made of course quite independently of the other two, enough time and other similar work having intervened to ensure complete forgetfulness of former results. The difference between our results may be criticised as large and it is large but I emphatically insist that individual differences of the same order repeatedly occur when cranial capacities are being determined. Almost every author claims for his method an accuracy of within 15 cc. In my former paper I have given reasons why I can only accept this as optimistic; it will be found that the most self-critical observers fail to confirm this estimate (e.g. 1). For myself, after ten years practice, I can state that I believe my final water method estimate, the average of five determinations checked by ten other collateral determinations, comes to within 40 cc. of the absolutely accurate volume. I do not believe that direct determination of cranial capacity permits of a much more accurate result than this. That one observer's consecutive determinations differ from each other by less than this amount does not mean that his average is necessarily close to absolute accuracy. Let another equally competent observer repeat the measurements and that hypothesis will be exploded on the instant. In general there is a much smaller difference between Miss Kuenzel's results and mine and we have worked together sufficiently to ensure subconscious uniformity of technique.

RESULTS OF MEASUREMENT BY WATER AND BY SEED

There is no practicable method of obtaining cranial capacity with absolute accuracy and there is no method of approximation which is not open to serious objection. For the purpose of this paper, and indeed for observations in general, we may claim that any method so far devised, if carried out by a competent observer after reasonable experience, will give an approximation of the absolute capacity within 40 cc. It is impossible to know whether the approximation is below or above the true value. Equally competent observers will undoubtedly give different figures. It is essential that we should be able to compare values obtained by one method in a sample of population with values of another sample obtained by a different method. Comparison of such figures for different seed or seed-substitute methods has been fully undertaken (see 5) but there is still lacking an efficient comparison of the water method with the seed method. For the bulk of our own material the water method is distinctly suitable and in my hands I believe that it gives more dependable results upon our own material, but that implies no adverse criticism of the seed method which indeed we use here for those skulls which cannot conveniently be measured by our water technique. Many observers give the average cranial capacity of a restricted sample of male White population as in the neighborhood of 1500 cc. Lee and Pearson gave it as 1504 cc. for Ranke's population of mediaeval Bavarians of which there were 100 in the sample (3). The Tübingen figure is 1494 cc. upon a series of 98 modern Wurtemburgers (4, 10). In the Reserve work so far published it appears as 1391 cc. upon a sample of 167. Suppose however our series had been measured by the seed method or the other series by our water method what then would have been the result. We cannot compare our samples so long as we have no adequate information regarding the relationship of estimates by both methods upon the same sample. It is this defect that we are about to correct.

Our standardized water technique upon the fresh skull in this laboratory calls for three measurements, each being the average of five separate successive determinations carried out always by the same observer. The first measurement is capacity of the cranium while the membranes are still in place: the second is capacity after removal of the membranes and the third is dura volume by displacement in water. It is obvious that these three measurements serve as controls and checks the one upon the others. They demand fifteen careful determinations. This is evidence merely of scrupulous effort but not, of course, of absolute accuracy. It has already been shown that the wet fresh cranium with membranes still in situ is of almost the same capacity as the dried cranium with membranes removed (5, 6, 7). In other words dura volume approximates the amount by which cranial capacity shrinks in drying. For practical purposes we may assume, in considering a sample of reasonable though restricted size, that the volume of the fresh cranium with membranes intact equals that of the dried macerated cranium. Table IV gives the figures for a sample of 46 male White crania before and after removal of membranes while still fresh, and again in the macerated dried state. Measurements of the fresh skull are obtained by the water method and those on the dry macerated skull by the seed method. The fresh determinations were all made by myself; the seed measurements are Miss Kuenzel's, each being the average of three determinations carried with scrupulous care following Hrdlička's instructions (2).

TABLE IV. FRESH AND DRY CAPACITIES COMPARED. 46 MALE WHITE CRANIA.

	Mean		S. D.	C. of V.
Water method:				
A. Membranes intact	1427	±10.77	108.31±7.62	7.59±0.53
B. Membranes removed	1481	±11.28	113.47±7.98	7.66±0.54
C. Seed method: dried, macerated	1506	±11.41	114.70±7.07	7.62±0.54
Deviation of C. from B	31.7	± 2.090	21.02±1.478	66.31

In Table IV lies the answer to our question. I have previously measured the dura volume in the male White cranium (6) and have also determined the shrinkage of the cranium in linear dimensions (7, 8) and in capacity (7) upon maceration and drying. The various methods of technique employed have been subjected to critical examination (5). There remained however a direct comparison of water and seed methods upon a single sample. The result now given shows that technique has a profound and direct effect upon the result obtained. It is necessary to add 80 cc. to the figure obtained for capacity of the fresh cranium with membranes intact in order to obtain a value strictly comparable with the figure resulting from a seed determination upon the dried macerated skull. Our average Reserve figure of 1391 cc. for the male White cranium becomes then 1471 cc. in terms of seed technique; and conversely the Tübigen average of 1494 cc. becomes 1414 cc. for comparison with our results. Small differences in linear dimensions as shown in Table V render quite intelligible and comparable the cranial capacities once the correction of 80 cc. is made. The question as to which method gives more accurate results in comparison with absolute capacity is another matter altogether. To compare the figures for seed and water in the same graduated cylinder, as has been done by others, or in a standard skull (natural or bronze), as has also been done, is merely beating the air. I myself have attained "accuracy" by these methods and some of the results have been published (see The natural crâne étalon, pp 121–124, and Relation of capacity in the fresh skull to that of the same skull dried, pp 127–130, both in Ref. 5). Nevertheless when we come to actual practical investigation of a population sample, Table IV gives our results. It is important to realise that the water method as employed by myself gives the maximum possible capacity. My results have been checked against those of an equally competent colleague and found to average some 50 cc. more than his (5).

TABLE V. COMPARISON OF CRANIAL MEASUREMENTS. MALE WHITES.

	Cran. cap.	Length S. R.	Length G.	Breadth	Aur. H.
1. Mediaeval Bavarians (3).	1424*	180.58	—	150.47	120.75
2. 46 skulls present paper.	1427	183.17	182.51	145.10	115.93
3. Modern Würtemburgers (10).	1414*	179.83	178.42	147.94	114.59
4. Standard W. R. U. collection (5)	1391	181.42	—	144.28	116.41

*Corrected by subtraction of 80 cc. to conform with the water technique.

Realising the grave fallacy in "accuracy" as above discussed I took cranium 1114 and measured its capacity by seed and by water while still fresh and with its membranes intact, a hazardous thing to do because one dare not dry out the cranium for fear of altering the dura volume, and seed expands when put into a wet cranium. Nevertheless the experiment was tried and the results were:—seed 1180 cc., water 1207 cc. Comparisons of personal accuracy by any method so far devised other than that summarized in Table IV give a false sense of security but are no indication of real accuracy in actual work.

Comparison of the variabilities in Table IV might be expected to give some indication of relative dependability of method. If one technique were to show a low variability and the other a high variability it would be justifiable to infer that the latter is less reliable. But Table IV gives no hint of this: the variabilities are as close as could be desired. Whether then shall we say that the water method or seed method gives a figure more nearly accurate for absolute capacity. To my own mind, admittedly prejudiced in favor of the water method, from long experience and taking note of the incompressibility of water, true cranial capacity lies nearer the water than the seed figure. But I am aware that others will hold equally strongly that absolute capacity is more nearly given by the seed determination. We are content to leave that gnarled problem with but one comment. At the end of Table IV we have prepared a summary of the results of the deviation without regard to sign of the seed figure from that which more nearly approaches it, namely the value given by the water method after removal of the membranes. There is a variability here of 66 per cent. In another place (9) I have illustrated my belief that when a variability of any dimension in the body exceeds 20 per cent there is grave doubt about the accuracy of the technique. When a variability approaches the amount here recorded we infer at once that of the two technical methods being compared, neither is above suspicion. Such is the situation in the investigation here recorded.

It is interesting and at the same time significant to observe the check figures brought out in this work. The difference between the seed average and the water average with membranes intact is 79 cc. The difference between the seed average and the water average with membranes removed is 25 cc. In a previous communication (6) I have given the revised average dura volume for the male White skull as 55 cc. This figure should be compared with the difference between the two water averages given in Table IV, namely 54 cc. Added to the 25 cc. mentioned above it closely approximates the seed-water difference of 79 cc. just recorded.

A difficulty which will occur to the reader of these pages is the difference between our standard Reserve average cranial capacity in White males, namely 1391 cc. (5) and the average of the 46 skulls here recorded. Table IV presents this latter average as 1427 cc. The sample upon which we are now engaged is more homogeneous (C. of V. 7.59 against 8.45) though much smaller (46 against 167) than the standard sample. In a paper which will shortly be published I intend to dwell upon this difference: it and others like it are of the utmost significance but a discussion is never convincing until facts can be presented without the smudge of uncertainty resulting from faulty discrimination or inadequate control of technique. If in numerous recent papers we have appeared to dilate at tedious length upon details of method; if we have seemed to be unnecessarily meticulous and critical over secondary aspects of the problem of cranial capacity, it has been the inevitable result of our determination to evaluate as accurately as circumstances permit the fluctuating yearly average of cranial capacity in our Reserve dissecting-room population. This discussion is the next one scheduled for publication and though it cannot throw a flood of light upon our population problem, at least it affords a glimmer in a very dark corner of anatomy.

SUMMARY

1. No method of direct determination of cranial capacity so far devised is without serious objection.
2. Every detail of the seed method has a profound influence upon the recorded result. So far as possible the technique should be rendered mechanical. Hrdlička's apparatus goes halfway in this direction.
3. On an average capacity estimated by the water method on the fresh skull with membranes still intact is less by 80 cc. than the result obtained with seed technique.
4. It is not presumed to decide finally which method of estimate comes nearer the true value of capacity. Personally I incline to the figure given by the water technique. All evidence from "standardization of method" and from practice with Bronzeschädel or crânes étalons is insufficient for convincing proof of accuracy in dealing with a population sample.
5. The variabilities of water and seed methods alike indicate that relative uniformity of successive determinations upon the same skull is an indication of mastery of technique rather than proof of approximation to true values.
6. The variability in deviation from each other of results obtained by seed and water suggests that neither technical method is above suspicion.
7. Without prejudice as to which method is the more accurate, results obtained by the water method upon one sample can be compared with results derived from another sample by the seed method only after correction of the final figure as demonstrated in this work. This correction should invariably be made for the convenience of other investigators and especially for the guidance of compilers.
8. The investigations recorded here enable us to bring our Reserve observations into proper relation with those of workers who have analysed other male White populations.

REFERENCES

1. Fawcett, (C. D.)—1902. A second study of the variation and correlation of the human skull with special reference to the Naqada crania. *Biometrika*, I, 408–467.
2. Hrdlička, (A.)—1920. Anthropometry, 8°, Wistar Inst., Philadelphia, 109–111.
3. Lee, (A.) and Pearson (K.)—1901. A first study of the correlation of the human skull. Phil. Trans. Roy. Soc. Series A, Vol. 196, 225–264.
4. Macdonell, (W. R.)—1904. A Study of the variation and correlation of the human skull with special reference to English crania. *Biometrika*, III, 191–244.
5. Todd, (T. W.)—1923. Cranial capacity and linear dimensions in White and Negro. *Am. J. Phys. Anthrop.*, VI, 97–194.
6. Todd, (T. W.)—1923. Dura volume in the male White skull. *Anat. Rec.*, XXVI, 263–274.
7. Todd, (T. W.)—1924. The effect of maceration and drying upon the linear dimensions of the green skull. *J. Anat.*, LVII, 336–356.
8. Todd, (T. W.)—1925. The nature of mummification and maceration illustrated by the male White skull. *J. Anat.*, LIX, 180–187.
9. Todd, (T. W.)—1924. Thickness of the male White cranium. *Anat. Rec.*, XXVII, 245–256.
10. Häcker, (R.)—1902. Die Anthropologischen Sammlungen Deutschlands, XVI. Tübingen, 44.

THE PTERION IN PRIMATES

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At the suggestion of Dr. Hrdlička I have undertaken the task of examining the crania of the lower primates and man in the United States National Museum collections for the purpose of observing the formation of the pterion. The results of the first part of this study, that on the ape skulls, is given below; the study on the human skulls will follow.

For this first series 1315 skulls were examined, of which 1071 were found to have the pterion visible on one or both sides. I here wish to express my thanks to Dr. Hrdlička for his help throughout the work, and to Mr. Gerrit S. Miller, Curator of the Division of Mammals, for the facilities afforded in that Division.

As is well known, three principal types of the pterion were recognized by Broca, the "pterion en H," the "pterion retourné," and the "pterion en K." In the first, the pterion resembles the letter H, the transverse bar being formed by the connection of the parietal with the great wing of the sphenoid, thus separating the frontal and temporal bones. This articulation is here called the spheno-parietal. The second variety, or "pterion retourné," is formed by the joining of the temporal squama with the frontal, and by a corresponding separation of the sphenoid and parietal. The name here used for this type is temporo-frontal. In the last type, the "pterion en K," the temporal, frontal, parietal and sphenoid meet at a point. This type it seemed most proper to include here as the first of the spheno-parietal articulations (point), followed by others in which the articulation is narrow, medium, and broad. While this distinction was observed in recording the individual cases, it seemed best in summarizing the data to combine the four types, so that in the following tables the spheno-parietal articulations, whether point, narrow, medium, or broad are included in one column.

Broca regarded the spheno-parietal as the normal human type, but stated that among certain lower races instances of a temporo-frontal connection were fairly common. The latter form was considered by him as the one occurring among most of the apes.

In 1878 Anoutchine published the results of his investigations on 15,169 human and 388 ape skulls. His results confirmed Broca's statement as to the relative frequency of the temporo-frontal articulation in the lower races, particularly the African Negroes, the Melanesians, and

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the Australians, but they also showed that this type was by no means a constant feature among the lower primates. As to the New World monkeys, Anoutchine stated that the presence of a temporo-frontal articulation was "a rare anomaly." He also noted in this group the marked extension backward of the malar bone, which produces a condition wholly unlike that in the Old World apes. In 1898 Ranke published an account of his researches on 4,862 human and 404 ape crania, and in 1911 Oppenheim records the formation of the pterion on 80 ape skulls. The results of these three writers will be compared later with those of the present study.

Topinard, in his "Éléments d'Anthropologie générale," 1885, discusses the pterion at some length. His views as to its formation in man are the same as those expressed by Broca. He also quotes Anoutchine's figures showing the percentage of temporo-frontal connections in different races of man, but seems to have disregarded or misquoted the latter's figures on the apes, though these were published at the same time as the data on the humans. Thus Topinard states that the spheno-parietal articulation is characteristic of the *Orang*, *Chimpanzee*, *Macaque*, *Cercopithecus*, *Cebus*, and *Mycetes* (*Alouatta*), while *Semnopithecus* shows the temporo-frontal type. Comparison with Anoutchine's data shows that of those genera described by Topinard as spheno-parietal, the *Chimpanzee*, *Macaque*, and *Cercopithecus* have the opposite, or temporo-frontal articulation, while *Semnopithecus* should be included in the spheno-parietal group.

In "Anatomical Observations on Orang Skulls," 1907, Hrdlička measured and described the Abbott collection of 26 Orang skulls from Borneo in the U. S. National Museum, and of the 18 crania in which the pterion was recognizable, reports the following conditions:

	Male	Female	
Parieto-sphenoidal articulation, both sides	6	5	
Parieto-sphenoidal articulation, right side	0	2	
Fronto-temporal articulation, both sides	3	0	
Fronto-temporal articulation, left side	0	2	
Parieto-sphenoidal articulation			72.2%
Fronto-temporal articulation			27.8%

Writer's Observations. On account of the entirely different conformation of the pterion in the New World and the Old World apes it was necessary in the following summary to deal with these two groups separately. Furthermore each series is divided into males, females, and those of which the sex is unknown. The skulls on which the sex could not be determined are mostly those of sub-adults. During the recording of the data these were kept separate, but when the whole series showed no perceptible difference in the degree of occurrence of either type of pterion in young or adult, it seemed unnecessary to include them in different tables.

In the following tables the skulls having the same articulation on both sides are kept separate from those in which the articulation on the two sides is different and from those in which only one side could be utilized. The latter condition was caused most often by the obliteration of the sutures, leaving only one side on which the pterion could be clearly distinguished; again one side would be broken away in the region of the pterion; or, in a few instances, the articulation was made doubtful by the presence of intercalated bones.

Following the three tables of Old World genera which give the numbers and percentages according to sex, there is a fourth table in which the data for male, female and unknown sex have been combined.

Examination of the summarized data in the fourth table shows that the two types of pterion are distributed throughout the Old World primates regardless of family. *Lemur*, *Propithecus*, *Nycticebus*, and *Galago*, according to the data available, are to be classed as 100% spheno-parietal; but when we leave these we see that of the other three great families, the *Simiidae*, *Colobidae*, and *Lasiopygidae*, no one type of pterion may be said to be characteristic. Such statements have been made, however. Sonntag, in "The Morphology and Evolution of the Apes and Man," p. 52, says that in the Old World monkeys the temporal bone articulates with the frontal. This is the usual condition among the *Lasiopygidae*, but even here exceptions are found, some of which are certainly significant, in particular *Macacus*, *Lasiopyga*, and *Erythrocebus*. As to the second large division of the Old World apes, the *Colobidae*, they are about equally divided, *Simias* and *Colobus* showing more than 50% of temporo-frontal articulations, while in *Nasalis* and *Presbytis* in more than half the cases the sphenoid joins the parietal. Similarly, this author gives the spheno-parietal as the type of the Gibbons and Orangs (p. 108 and 113), while it is quite clear that these two genera show both forms of the pterion. On p. 40, finally, in describing the New World genera, Sonntag says, "on the side of the skull the parietal articulates with the malar bone, thus separating the frontal and alisphenoid." While this is the general condition among American monkeys, one important genus, *Alouatta*, is an exception, for here in more than half the cases the malar and parietal bones are separated.

FORM OF PTERION IN THE OLD WORLD PRIMATES
SEX: MALE

Genus	Skulls in Which the Pterion Could Be Determined		Pterions With Both Sides		Temporo-Frontal Articulations One Side (Spheno-Parietal Articulation On Other Side)		Temporo-Frontal Articulations One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Temporo-Frontal Articulations		Pterions With Both Sides		Spheno-Parietal Articulations One Side (Temporo-Frontal Articulation On Other Side)		Spheno-Parietal Articulations One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Parietal Articulations	
	Both Sides	One Side	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Orang—Borneo	30	1	9	*29.0*	1	*3.2*	—	—	19	*31.2*	20	*64.5*	1	*3.2*	1	*3.2*	42	*68.8*
Orang—Sumatra	6	—	6	*100.*	—	—	—	—	12	*100.*	—	—	—	—	—	—	—	—
Gorilla	17	1	17	*94.4*	—	—	1	*5.5*	35	*100.*	—	—	—	—	—	—	—	—
Chimpanzee	10	—	9	*90.*	1	*10.*	—	—	19	*95.0*	—	—	1	*10.*	—	—	1	*5.0*
Hylobates	14	3	4	*23.5*	1	*5.9*	1	*5.9*	10	*32.3*	9	*52.9*	1	*5.9*	2	*11.8*	21	*67.7*
Symphalangus	2	1	1	*33.3*	—	—	—	—	2	*40.0*	1	*33.3*	—	—	1	*33.3*	3	*60.0*
Simias	3	—	2	*66.6*	1	*33.3*	—	—	5	*83.3*	—	—	1	*33.3*	—	—	1	*16.6*
Nasalis	18	2	—	—	—	—	—	—	—	—	18	*90.0*	—	—	2	*10.0*	38	*100.*
Colobus	31	1	19	*59.4*	5	*12.5*	1	*3.1*	44	*69.8*	7	*21.9*	5	*12.5*	—	—	19	*30.2*
Presbytis	53	7	9	*15.*	4	*6.7*	2	*3.3*	24	*21.2*	40	*66.7*	4	*6.7*	5	*8.3*	89	*78.8*
Macacus	117	8	102	*81.6*	5	*4.0*	5	*4.0*	214	*88.4*	10	*8.0*	5	*4.0*	3	*2.4*	28	*11.6*
Cynopithecus	10	—	10	*100.*	—	—	—	—	20	*100.*	—	—	—	—	—	—	—	—
Magus	4	2	3	*50.*	—	—	2	*33.3*	8	*80.0*	1	*16.7*	—	—	—	—	2	*20.0*
Papio	26	—	24	*92.3*	—	—	—	—	48	*92.3*	2	*7.7*	—	—	—	—	4	*7.7*
Cynocephalus	4	—	4	*100.*	—	—	—	—	8	*100.*	—	—	—	—	—	—	—	—
Cercocebus	4	—	3	*75.*	1	*25.*	—	—	7	*87.5*	—	—	1	*25.*	—	—	1	12.5
Erythrocebus	3	—	—	—	—	—	—	—	—	—	3	*100.*	—	—	—	—	6	*100.*
Theropithecus	1	—	1	*100.*	—	—	—	—	2	*100.*	—	—	—	—	—	—	—	—
Lasiopyga	54	3	26	*45.6*	5	*8.8*	—	—	57	*51.4*	23	*40.4*	5	*8.8*	3	*5.3*	54	*48.6*
Lemur	5	—	—	—	—	—	—	—	—	—	5	*100.*	—	—	—	—	10	*100.*
Propithecus	3	—	—	—	—	—	—	—	—	—	3	*100.*	—	—	—	—	6	*100.*
Nycticebus	7	—	—	—	—	—	—	—	—	—	7	*100.*	—	—	—	—	14	*100.*
Galago	15	—	—	—	—	—	—	—	—	—	15	*100.*	—	—	—	—	30	*100.*

SEX: FEMALE

Genus	Skulls in Which the Pterion Could Be Determined		Pterions With Both Sides		Temporo-Frontal One Side (Spheno-Parietal Articulation onOther Side)		Articulations One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Temporo-Frontal Articulations		Pterions With Both Sides		Spheno-Parietal One Side (Temporo-Frontal Articulation on Other Side)		Articulations One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Parietal Articulations	
	Both Sides	One Side	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Orang—Borneo	29	1	5	*16.7*	5	*16.7*	—	—	15	*25.4*	19	*63.3*	5	*16.7*	1	*3.3*	44	*74.6*
Orang—Sumatra	7	—	7	*100.*	—	—	—	—	14	*100.*	—	—	—	—	—	—	—	—
Gorilla	6	—	6	*100.*	—	—	—	—	12	*100.*	—	—	—	—	—	—	—	—
Chimpanzee	4	—	4	*100.*	—	—	—	—	8	*100.*	—	—	—	—	—	—	—	—
Hylobates	15	1	6	*37.5*	2	*12.5*	1	*6.3*	15	*48.4*	7	*43.8*	2	*12.6*	—	—	16	*51.6*
Symphalangus	3	—	—	—	1	*33.3*	—	—	1	*16.7*	2	*66.6*	1	*33.3*	—	—	5	*83.3*
Simias	6	—	4	*66.6*	1	*16.7*	—	—	9	*75.*	1	*16.7*	1	*16.7*	—	—	3	*25.*
Nasalis	8	1	—	—	1	*11.1*	—	—	1	*5.9*	7	*77.7*	1	*11.1*	1	*11.1*	16	*94.1*
Colobus	26	—	20	*76.9*	2	*7.7*	—	—	42	*80.8*	4	*15.4*	2	*7.7*	—	—	10	*19.2*
Presbytis	91	14	34	*32.3*	7	*6.7*	4	*3.8*	79	*40.3*	50	*47.6*	7	*6.7*	10	*9.5*	117	*59.7*
Macacus	74	5	65	*82.3*	—	—	4	*5.0*	134	*87.6*	9	*11.4*	—	—	1	*1.3*	19	*12.4*
Simia	2	—	2	*100.*	—	—	—	—	4	*100.*	—	—	—	—	—	—	—	—
Cynopithecus	8	—	8	*100.*	—	—	—	—	16	*100.*	—	—	—	—	—	—	—	—
Magus	10	1	10	*90.9*	—	—	1	*9.1*	21	*100.*	—	—	—	—	—	—	—	—
Papio	19	—	19	*100.*	—	—	—	—	38	*100.*	—	—	—	—	—	—	—	—
Cercocebus	2	—	2	*100.*	—	—	—	—	4	*100.*	—	—	—	—	—	—	—	—
Erythrocebus	1	—	—	—	—	—	—	—	—	—	1	*100.*	—	—	—	—	2	*100.*
Theropithecus	1	—	1	*100.*	—	—	—	—	2	*100.*	—	—	—	—	—	—	—	—
La iopyga	55	5	31	*51.7*	3	*5.0*	4	*6.6*	69	*60.0*	21	*35.0*	3	5.0	1	*1.6*	46	*40.0*
Lemur	4	—	—	—	—	—	—	—	—	—	4	*100.*	—	—	—	—	8	*100.*
Nycticebus	4	1	—	—	—	—	—	—	—	—	4	*75.0*	—	—	1	*25.0*	9	*100.*
Galago	10	2	—	—	—	—	—	—	—	—	10	*83.3*	—	—	2	*16.6*	22	*100.*

Sex: Unknown

Genus	Skulls in Which the Pterion Could Be Determined		Pterions With Both Sides		Temporo-Frontal One Side (Spheno-Parietal Articulation On Other Side)		Articulations One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Temporo-Frontal Articulations		Pterions With Both Sides		Spheno-Parietal One Side (Temporo-Frontal Articulation On Other Side)		Articulations One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Parietal Articulations	
	Both Sides	One Side	Number	Per-cent	Number	Per-cent	Number	Per-cent	Number	Per-cent	Number	Per-cent	Number	Per-cent	Number	Per-cent	Number	Per-cent
Orang—Borneo	1	—	—	—	—	—	—	—	—	—	1	100.	—	—	—	—	2	100.
Gorilla	1	—	1	100.	—	—	—	—	2	100.	—	—	—	—	—	—	—	—
Chimpanzee	7	—	7	100.	—	—	—	—	14	100.	—	—	—	—	—	—	—	—
Colobus	1	—	1	100.	—	—	—	—	2	100.	—	—	—	—	—	—	—	—
Presbytis	12	1	1	7.7	1	7.7	—	—	3	12.0	10	76.9	1	7.7	1	7.7	22	88.0
Macacus	5	1	5	83.3	—	—	1	16.6	11	100.	—	—	—	—	—	—	—	—
Cercocebus	5	—	4	80.	—	—	—	—	8	80.	1	20.	—	—	—	—	2	20
Lasiopyga	4	—	4	1 0.	—	—	—	—	8	100.	—	—	—	—	—	—	—	—
Lemur	2	—	—	—	—	—	—	—	—	—	2	100.	—	—	—	—	4	100.

Sex: Male, Female and Unknown, Old World

Genus	Skulls in which the Pterion Could Be Determined		Total Number of Pterions Having Temporo-Frontal Articulation		Total Number of Pterions Having Spheno-Parietal Articulation	
	Both Sides	One Side	Number	Percent	Number	Percent
Orang—Borneo	60	2	34	27.9	88	72.1
Orang—Sumatra	13	—	26	100.	—	—
Gorilla	24	1	49	100.	—	—
Chimpanzee	21	—	41	97.6	1	2.4
Hylobates*	29	4	25	40.3	37	59.7
Symphalangus	5	1	3	27.3	8	72.7
Simias	9	—	14	77.7	4	22.2
Nasalis	26	3	1	1.8	54	98.2
Colobus	58	1	88	75.2	29	24.8
Presbytis	156	22	106	31.7	228	68.3
Macacus	196	14	359	88.7	47	11.3
Cynopithecus	18	—	36	100.	—	—
Simia	2	—	4	100.	—	—
Magus	14	3	29	93.5	2	6.5
Papio	45	—	86	95.6	4	4.4
Cynocephalus	4	—	8	100.	—	—
Cercocebus	11	—	19	86.4	3	13.6
Erythrocebus	4	—	—	—	8	100.
Theropithecus	2	—	4	100.	—	—
Lasiopyga	113	8	134	57.3	100	42.7
Lemur	11	—	—	—	22	100.
Nycticebus	11	1	—	—	23	100.
Propithecus	3	—	—	—	6	100.
Galago	25	2	—	—	52	100.

*In one female Hylobates skull, Cat. 83263, the parietal joins with both the sphenoid and malar. This genus shows a much more pronounced backward extension of the malar than do other Old World apes, in this respect being similar to the American forms.

It appears, therefore, that we are justified in saying that neither of the two main types of pterion is a constant feature of any family of primates as a whole, with perhaps the exception of the *Lemuroidea*.

As to sex, the conditions among the Old World apes are as follows:

Males

Number of skulls	466
Number of skulls in which articulation of the pterion on one side is different from that on other side	24 (5.2%)
Number of pterions	903
Number of pterions having temporo-frontal articulations	534 (59.1%)
Number of pterions having spheno-parietal articulations	369 (40.9%)

Females

Number of skulls	416
Number of skulls in which articulation of the pterion on one side is different from that on other side	22 (5.3%)
Number of pterions	801
Number of pterions having temporo-frontal articulations	484 (60.4%)
Number of pterions having spheno-parietal articulations	317 (39.6%)

New World Monkeys. Among the New World monkeys an entirely different formation of the pterion is met with. In every skull examined

FORM OF PTERION IN NEW WORLD MONKEYS
SEX: MALE

Genus	Skulls in Which the Pterion Could Be Determined		Spheno-Parietal Articulations								Spheno-Malar-Parietal Articulations							
			Pterions With Both Sides		One Side (Different Articulation of Pterion on Other Side)		One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Parietal Articulation		Pterions With Both Sides		One Side (Different Articulation of Pterion on Other Side)		One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Malar-Parietal Articulation	
	Both Sides	One Side	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Alouatta	15	1	9	56.3	—	—	—	—	18	58.1	6	37.5	—	—	1	6.2	13	41.9
Ateles	14	—	2	14.3	2	14.3	—	—	6	21.4	10	71.4	2	14.3	—	—	22	78.6
Pithecia	2	—	—	—	—	—	—	—	—	—	2	100.	—	—	—	—	4	100.
Saimiri	6	—	—	—	—	—	—	—	—	—	6	100.	—	—	—	—	12	100.
Cebus	22	1	2	8.7	—	—	—	—	4	8.9	20	86.9	—	—	1	4.4	41	91.1
Lagothrix	3	—	—	—	—	—	—	—	—	—	3	100.	—	—	—	—	6	100.
Callithrix	1	1	—	—	—	—	—	—	—	—	1	50.	—	—	1	50.	3	100.
Callicebus	2	—	—	—	—	—	—	—	—	—	2	100.	—	—	—	—	4	100.
Seniocebus	2	—	—	—	—	—	—	—	—	—	2	100.	—	—	—	—	4	100.
Oedipomidas	6	—	—	—	—	—	—	—	—	—	6	100.	—	—	—	—	12	100.
Leontocebus	2	—	—	—	—	—	—	—	—	—	2	100.	—	—	—	—	4	100.

SEX: FEMALE

Genus	Skulls in Which the Pterion Could Be Determined		Pterions With Both Sides		Spheno-Parietal Articulations						Pterions With Both Sides		Spheno-Malar-Parietal Articulations					
					One Side (Different Articulation of Pterion on Other Side)		One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Parietal Articulations				One Side (Different Articulation of Pterion on Other Side)		One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Malar-Parietal Articulations	
	Both Sides	One Side	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alouatta	5	2	2	28.5	—	—	1	14.2	5	41.7	3	42.9	—	—	1	14.2	7	58.3
Ateles	15	—	3	20.	1	6.7	—	—	7	23.3	11	73.3	1	6.7	—	—	23	76.7
Aotus	2	—	—	—	—	—	—	—	—	—	1	50.	—	—	—	—	2	50.
Saimiri	2	—	—	—	—	—	—	—	—	—	2	100.	—	—	—	—	4	100.
Cebus	13	—	—	—	—	—	—	—	—	—	13	100.	—	—	—	—	26	100.
Callithrix	6	—	—	—	—	—	—	—	—	—	6	100.	—	—	—	—	12	100.
Lagothrix	1	—	—	—	—	—	—	—	—	—	1	100.	—	—	—	—	2	100.
Seniocebus	2	—	—	—	—	—	—	—	—	—	2	100.	—	—	—	—	4	100.
Leontocebus	4	1	—	—	—	—	—	—	—	—	4	80.	—	—	1	20.	9	100.

SEX: UNKNOWN

Genus	Skulls in Which the Pterion Could Be Determined		Pterions With Both Sides		Spheno-Parietal Articulations						Pterions With Both Sides		Spheno-Malar-Parietal Articulations					
					One Side (Different Articulation of Pterion on Other Side)		One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Parietal Articulation				One Side (Different Articulation of Pterion on Other Side)		One Side (Pterion on Other Side Could not Be Determined)		Total Number of Pterions Having Spheno-Malar-Parietal Articulation	
	Both Sides	One Side	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alouatta	5	—	2	40.	1	20.	—	—	5	50.	2	40.	1	20.	—	—	5	50.
Ateles	4	—	1	25.	—	—	—	—	2	25.	3	75.	—	—	—	—	6	75.
Cebus	5	—	—	—	—	—	—	—	—	—	5	100.	—	—	—	—	10	100.
Lagothrix	1	—	—	—	—	—	—	—	—	—	1	100.	—	—	—	—	2	100.
Callithrix	1	—	—	—	—	—	—	—	—	—	1	100.	—	—	—	—	2	100.
Callicebus	2	—	—	—	—	—	—	—	—	—	1	50.	—	—	—	—	2	50.

SEX: MALE, FEMALE AND UNKNOWN, NEW WORLD

Genus	Skulls in Which the Pterion Could Be Determined		Total Number of Pterions Having Spheno-Parietal Articulation		Total Number of Pterions Having Spheno-Malar-Parietal Articulation	
	Both Sides	One Side	Number	Percent	Number	Percent
Alouatta	25	3	28	*52.8*	25	*47.2*
Ateles	33	—	15	*22.7*	51	*77.3*
Aotus*	2	—	—	—	2	*50.*
Pithecia	2	—	—	—	4	*100.*
Saimiri	8	—	—	—	16	*100.*
Cebus	40	1	4	*4.9*	77	*95.1*
Lagothrix	5	—	—	—	10	*100.*
Callithrix	8	1	—	—	17	*100.*
Callicebus*	4	—	—	—	6	*75.*
Seniocebus	4	—	—	—	8	*100.*
Oedipomidas	6	—	—	—	12	*100.*
Leontocebus	6	1	—	—	13	*100.*

*In three instances the parietal was found to articulate with the malar alone, as follows: Aotus, female, one side; Callicebus, sex unknown, both sides; Cacajo, female, both sides, the latter specimen being the only representative of the genus examined.

a wide separation of the frontal and temporal bones was observed, but in most cases this is to be attributed not to a broad articulation of the sphenoid with the parietal as was found among certain genera of Old World apes but to the presence of an additional bone, the malar, in the region of the pterion. The malar, instead of being cut off from the parietal by the union of the frontal and sphenoid as is usual among other primates, here as a rule extends back from the orbits and enters as a wedge of varying size between the frontal and sphenoid, and connects directly with the parietal. So that in the American monkeys represented in this series the articulation of the parietal may be with the sphenoid, the sphenoid and malar, or, in a few exceptional cases, with the malar alone. For this reason it was necessary to present the data on the American monkeys in separate tables.

As to sex, conditions in the New World monkeys are as follows:

Males

Number of skulls	79
Number of skulls in which articulation of the pterion on one side is different from that on other side	2 (2.5%)
Number of pterions	153
Number of pterions having spheno-parietal articulations	28 (18.3%)
Number of pterions having spheno-malar-parietal articulations	125 (81.7%)

Females

Number of skulls	52
Number of skulls in which articulation of the pterion on one side is different from that on other side	1 (2.0%)
Number of pterions	101
Number of pterions having spheno-parietal articulations	12 (11.9%)
Number of pterions having spheno-malar-parietal articulations	89 (88.1%)

Of the 147 skulls of American monkeys examined having the pterion visible on one or both sides, there was not observed one instance of a temporo-frontal articulation. As stated above, the separation of these two bones is wider than in the Old World apes, being due to the articulation of the parietal with both the sphenoid and the malar. *Alouatta* is the only American genus in which, in more than half the cases, the malar does not join with the parietal. Temporo-frontal articulations have been reported among the New World monkeys, however. Ranke states that it was found in four cases out of 53, or 7.5%, and Oppenheim found one *Hapale* (*Callithrix*) skull showing this condition among the four examined.

In the following table the first three columns contain the results recorded by Anoutchine, Oppenheim, and Ranke, and the last the results of the present study.

	Anoutchine		Ranke		Oppenheim		U. S. Nat. Mus.	
Anthropoid Apes	Number of Skulls	Percent Having Temporo-Frontal Articulations	Number of Skulls	Percent Having Temporo-Frontal Articulations	Number of Skulls	Percent Having Temporo-Frontal Articulations	Number of Skulls	Percent (of Pterions) Having Temporo-Frontal Articulations
Chimpanzee......	54	88.9	70 (combined with Anoutchine's)	77.0	21	62.0	21	97.6
Gorilla..........	32	100.	35 (combined with Anoutchine's)	100.	—	—	25	100.
Orang..........	65	29.2	307 (combined with Anoutchine's)	33.6	11	36.3	62	27.9
Gibbon	24	12.5	73 (combined with Anoutchine's and Kirchner's)	13.7	—	—	33 (Hylobates) 6 (Symphalangus)	40.3 27.3
Old World Apes								
Cynocephalus.....	68	80.8	—	—	18	77.7	4	100.
Macacus.........	58	80.6	20 (Macaque and Inuus)	90.	6	66.6	210	88.7
Cercopithecus....	34	76.5	23 (with Cercocebus)	74.	—	—	121	57.3
Semnopithecus....	53 (Colobus and Rhinopithecus)	47.1	21 (with Colobus & Rhinopithecus)	42.3	20	35.	59 (Colobus)	75.2
New World Monkeys								
Mycetes (Alouatta)	—	—	1	0	—	—	28	0
Ateles...........	—	—	2	50.	—	—	14	0
Lagothrix........	—	—	3	0	—	—	3	0
Cebus...........	—	—	17	0	—	—	23	0
Callithrix........	—	—	7 (Callicebus?)	0	—	—	2	0
Pithecia.........	—	—	4	50.	—	—	2	0
Chrysothrix (Saimiri)	—	—	1	0	—	—	6	0
Hapale (Callithrix)	—	—	8	12.5	4	25.	—	—
Lemuroidea......	—	—	26	0	—	—	52	0

Comparison of the above sets of figures so far as the anthropoid apes are concerned, shows the same results for the Gorillas and close agreement as to the Orangs also, if those given by Anoutchine were from Borneo, as probably was the case, since Ranke's 307 specimens, which included Anoutchine's 65, were from Borneo. Of the Borneo specimens in the National Museum only 27.9% have the temporo-frontal articulation, while the Sumatra Orang is fully 100% in this class. This is an interesting fact because of other differences that have been observed to exist before between these two Orangs. Most zoologists appear to be of the opinion that only one species of the Orang exists, but that there are several varieties. At any rate the formation of the pterion, according to the material here available, does differ considerably in these two varieties.

The greatest difference between our figures and those of Anoutchine and Ranke is shown in the Gibbons, where the latter records 13.7% of temporo-frontal connections in 73 skulls including those of Anoutchine, while the writer found 40.3% of pterions of this type in 33 skulls of *Hylobates*, and 27.3% in the 6 crania of *Symphalangus.*

As to the lower forms of the Old World apes our figures for *Cynocephalus* are in fairly close agreement with those of the previous writers. Our percentage for the *Macaque* is close to those of Anoutchine and Ranke but is higher than that reported by Oppenheim. The six Macaques recorded by Oppenheim are of one species, *M. nemestrinus*, which is represented in our series by 15 crania, each of which had temporo-frontal articulations on both sides.

Colobus and *Rhinopithecus* are grouped together by Anoutchine and designated under the family or sub-family name *Semnopithecinae* (*Colobidae*). They are given as having 47.1% temporo-frontal articulations, while according to our figures, *Colobus* shows 75.2% of this type. However, since *Rhinopithecus* is not represented in the National Museum collections, no accurate comparison of our results can be made. Ranke gives the temporo-frontal articulation for these genera as 42.3%, but it is not clear whether his term "*Semnopithecus*" is used as a family or sub-family name to include *Colobus* and *Rhinopithecus*, or as that of the separate genus *Semnopithecus* (*Presbytis*). One of the two species given by Oppenheim, *Semnopithecus nemaeus*, is not represented in the National Museum collections. *S. maurus*, the other species, may be either *Presbytis aurata* or *P. cristatus*, only the latter species, consisting of 18 skulls and having 38.9% temporo-frontal articulations, being included in the present paper.

Ranke combines *Cercopithecus* (*Lasiopyga*) with *Cercocebus*, so the individual percentages of the two genera are not known. Anoutchine's percentage of temporo-frontal articulations in *Cercopithecus* (*Lasiopyga*) is higher than ours, but it may be worth while noting that in the present series of *Lasiopyga*, one sub-species, *L. pygerthra arenaria*, differs considerably from the others. There are 13 out of 17 skulls in this sub-species in which a spheno-parietal articulation is present on one or both sides, while the predominating type of pterion in the other species and sub-species of *Lasiopyga* is the temporo-frontal. If this sub-species were left out of our series, the percentage of temporo-frontal articulations for the genus *Lasiopyga* would be considerably increased.

Another case of marked differences within a genus was observed in our series of *Presbytis*, where the species *P. natunae* (8 skulls) and *P. carimatae* (4 skulls) were both 100% temporo-frontal, while the prevailing type of pterion in the other species of this genus is spheno-parietal.

In comparing the results of the present paper with those of the three previous writers it should be borne in mind that the methods of approach were somewhat different. Anoutchine and Ranke were interested only in determining the degree of occurrence of the temporo-frontal articulation (processus frontalis ossis temporis). Variations from this type, whether caused by a spheno-parietal articulation or by wormian bones, were disregarded. Furthermore a distinction was not always made by them between the skulls having a temporo-frontal articulation on both sides and those having it on one side only. Oppenheim alone recorded spheno-parietal and other forms of the pterion, and usually stated that a certain articulation was found on both sides, but again we are left in doubt as to the disposition of skulls in which the pterion on one side may have been unrecognizable or in which the articulations of the two sides may have differed.

Another difficulty is presented in terminology. Considerable confusion still exists as to the correct specific, generic and family names of the various primates. This is due principally to the more or less constant revision of the names which takes place whenever it is found that an earlier writer has used in a different connection a name applied at the time of discovery to another species or genus. Thus one cannot always be certain as to just what species or genus a writer of twenty to forty years ago may refer. In consideration of these facts, it is possible that there are no great discrepancies between our results and those of the previous writers, except in the case of the New World monkeys where Oppenheim and Ranke report several instances of a temporo-frontal connection.

BIBLIOGRAPHY

Anoutchine (D.)—Sur la conformation du pterion chez diverses races humaines et les primates. *Bull. Soc. d'Anthrop. Paris*, 1878, I, 350–353.

Broca (P.)—Ostéologie du crâne. *Bull. Soc. d'Anthrop. Paris*, 1875, X, 353–354.

Hrdlička (A.)—Anatomical observations on a collection of Orang skulls from Western Borneo. *Proc. U. S. Nat. Mus.* 1907, XXXI, 550.

Le Double (A. F.)—Traité des variations des os du crâne de l'homme. Paris, 1903, 300–305.

Martin (R.)—Lehrbuch der Anthropologie. Jena, 1914, 774–780.

Oppenheim (S.)—Zur typologie des Primatencraniums. *Z. Morph. & Anthrop.*, 1911–12, XIV, 1–203.

Ranke (J.)—Der stirnfortsatz der Schlafenschuppe. *Sitzb. mathem-phys. Cl. Ak. Wiss.*, 1898, XXVIII, 234–241.

Sonntag (C. F.)—The Morphology and Evolution of the Apes and Man. Lond., 1924.

Sullivan (L. R.)—The frequency and distribution of some anatomical variations in American crania. *Anthrop. Papers Am. Mus. Nat. Hist.*, 1922, XXIII, Pt. V, 219–220.

Topinard (P.)—Éléments d'Anthropologie générale. Paris. 1885, 795–799.

THE RELIABILITY OF MEASUREMENTS BASED UPON SUBCUTANEOUS BONY POINTS

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INTRODUCTION

It is generally recognized among Anthropologists that measurements made on the living body are reliable to within about 5 mm. and this is the standard to which beginners are trained. We have no information however to show just how much discrepancy may be expected as a result of instrumental method, apart altogether from the deviations due to different observers.

In order to save time in the field it is frequently decided to leave out larger measurements and compute these later by the addition of the dimensions of the component parts. We have no information to guide us regarding the reliability of these computed measurements.

The observations here recorded were devised to give the data from which this lacking information might be gleaned. The work was done upon cadavera. The bony points serving as landmarks were marked upon the overlying skin by crosses cut through the epidermis. Thus we sought to avoid errors from failure to return always to the identical point. All observations were carried by myself so that the worker's error might remain constant and thus be eliminated from consideration. Measurements in all observations on pelvis and arm have been made with Martin's Anthropometer (Stangenzirkel).

The first part of the investigation relates to the recognition of bony points through the skin. For this purpose the anterior superior iliac spines were chosen. These bony landmarks are somewhat triangular with the apex downwards: the cross is cut over the downwardly directed apex. In emaciated individuals they are always readily recognizable but are less readily palpated in corpulent bodies. The difficulty is enhanced after death by solidification of the subcutaneous fat. We are

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not concerned with individuals but with a significant sample and therefore may safely work with mean values provided the mean is checked by its probable error and by the variability of the sample. In the stout living body a subcutaneous bony point is more easily palpated than on the dead but on the other hand it is not practicable to mark the living so exactly as the dead and the living skin slips out of place more readily than on the cadaver. I find the crosses of little service for marking the iliac spines since, on embalming, the skin becomes shifted relative to these bony points. In consequence the accuracy of repeated location of the same bony point may be assumed to be approximately the same in the living and on the dead.

The second part of the work relates to the summation of smaller measurements in the computation of greater dimensions of which the direct measurements are factors. For this purpose the left arm was chosen. The bony points required are the acromiale, radiale, stylion and dactylion (III). Definitions of all these points are accurately laid down in Martin's Lehrbuch (Martin, R. Lehrbuch der Anthropologie. Jena, 1914, S 122) and it is unnecessary to repeat them here.

The dimensions used in the study of arm length are the following:

45. Entire arm length. Acromiale to dactylion.
46. Arm length without hand. Acromiale to stylion.
47. Upper arm length. Acromiale to radiale.
48. Forearm length. Radiale to stylion.
49. Hand length. Stylion to dactylion.
8. Height of left acromion from floor. Acromiale to floor.
11. Height of left dactylion from floor. Dactylion to floor.

For measurements 8 and 11 the cadaver was suspended from a pulley in the ceiling by means of a rope and a pair of ice tongs, the jaws of which have been rounded so as to fit into the ear-holes. The feet are planted squarely on the floor so that heel and ball of foot are both firmly in contact with the cement; the body is not stretched and the knees are not bent: the arms hang down. If rigor mortis has resulted in a foot-drop the tendo achillis of both legs is cut. This procedure has been adopted as a routine in the later part of the investigation because it simplifies the work. Of course rigor mortis may result in modifying the position of the shoulder but we are not concerned with the precise position of the acromiale relative to the floor. The error in exact determination of this measurement is cancelled by the same error reflected in measurement 11. Every individual is not able to extend the forearm fully at the elbow: this source of error in our work has not disconcerted me at all because it occurs in the living as in the dead and is precisely one of the factors the influence of which I desire to demonstrate.

RELIABILITY OF DETERMINATION OF BONY POINTS

In the first part of the investigation it was decided to note the bispinous diameter of the pelvis upon the cadaver and compare the result with the bispinous diameter measured on the torso after skin and other soft tissues had been stripped off and the actual bony points laid bare. Inasmuch however as the cadaver measurements are made upon the body before embalming and the torso determinations are made after embalming one must find out if any change in this dimension is brought about by the embalming process. We use three gallons of fluid in our standard embalming technique and it is conceivable, though not probable, that some of this fluid, injected under 15 lbs. pressure, may produce an effect upon the symphysial and sacro-iliac ligaments.

TABLE I. FRESH AND EMBALMED CADAVERA.

	Number	Mean	Standard deviation	Coefficient of Variation
		Bispinous breadth fresh		
Male White............	38	239.6±2.116	19.34±1.496	8.08±0.625
Male Negro............	16	220.4±3.546	21.03±2.507	9.56±1.140
		Bispinous breadth after 3 gallons		
Male White............	38	239.9±2.110	19.28±1.492	8.03±0.621
Male Negro............	16	220.4±3.566	21.15±2.522	9.61±1.146

Table I gives the result of a preliminary examination of the effect of embalming upon the bispinous diameter. A sample of 38 male White cadavera was taken and checked by a further sample of 16 male Negro cadavera. Each body was measured before and after embalming. A glance at the means, their errors and the variabilities of the samples shows that no change has occurred. We may therefore proceed confidently to a comparison of measurements on the fresh cadaver and the torso.

TABLE II. FRESH CADAVER.

	Number	Bispinous breadth Mean	Standard deviation	Coefficient of Variation
Male White............	100	246.1±1.157	17.16±0.818	6.97±0.332
Male Negro............	100	226.9±1.219	18.08±0.862	7.96±0.380
		TORSO		
		Bispinous breadth		
Male White............	100	241.4±1.189	17.64±0.841	7.32±0.349
Male Negro............	98	224.1±1.121	16.46±0.793	7.35±0.354

Table II shows the reliability of measurement of the bispinous diameter before and after stripping off the soft tissues. The sample remains the same for both determinations except that for some reason two of the Negro bodies were not measured immediately before maceration. The measurement in the fresh cadaver is 4.7 mm. too large in the male Whites and 2.8 mm. too great in the male Negroes.

We may conclude then that on a significant sample of a population the bispinous diameter will be correct to within 5 mm. But of course it must not be assumed that this will be invariably true for each individual cadaver.

RELIABILITY OF SUMMATION OF FACTORIAL MEASUREMENTS

To test this I took 100 male White cadavera and determined the several arm lengths already set forth. From these measurements it is possible to find the entire arm length by several methods. It may be measured directly (45). It may be obtained from two factorial measurements: (46) and (49) added together or (11) subtracted from (8). It may be computed from the addition of three measurements (47) + (48) + (49).

TABLE III

No. 100 Male Whites	Mean	Standard deviation	Coefficient of Variation
L. arm length (45)	759.7±2.036	30.19±1.440	3.97±0.189
L. arm without hand (46)	569.4±1.611	23.88±1.139	4.20±0.200
L. upper arm length (47)	332.6±1.108	16.43±0.784	4.93±0.235
L. forearm length (48)	249.1±0.833	12.35±0.589	4.96±0.237
L. hand length (49)	186.9±0.627	9.29±0.443	4.97±0.237
L. shoulder height (8)	1412.7±3.983	59.05±2.816	4.11±0.196
L. middle finger height from ground (11)	649.5±2.833	42.00±2.003	6.47±0.309

Table III gives the several means, their errors and the variabilities of the samples. In general the smaller the measurement the greater the variability. This is of course in part a reflection of the accuracy of measurement, small errors tending to become less obvious in greater dimensions. We shall not stay to discuss this matter at length here. Undoubtedly the comparatively large variability in (11) is due to the difficulty in straightening the arm in life and after death. The small variability in (8) occurs in spite of the variation in position of the shoulder resulting from rigor mortis.

TABLE IV.

(a)	46+49	Av. 756.25	Dev. of 45 from 46+49	Av. 6.05
(b)	47+48+49	Av. 769.12	Dev. of 45 from 47+48+49	Av. 10.76
(c)	8—11	Av. 763.36	Dev. of 45 from 8—11	Av. 7.66

Table IV gives the deviations of computed entire arm length from entire arm length directly measured. Note that the figures in this table are average deviations, not deviations of one average from another. The latter are naturally smaller than the former and can be calculated at a glance.

From Table IV we observe that when two measurements are summated (46 + 49) the result in a significant sample differs from the determination made directly by something like 5 mm.; when three measurements are summated the result deviates from direct measurement by about 10 mm. In the somewhat more difficult experiment represented by subtracting (11) from (8) the deviation lies between these two limits. It is possible then to deduce from these observations that computation of a dimension by the summation of factorial measurements is reliable only to within about 5 mm. if two factors are employed, and to within about 10 mm. if three factors are used. Into the error resulting from summation of (47) (48) and (49) there enters that deviation which is due to the tendency to obtain a short determination for (45) resulting from inability in some individuals to straighten the arm fully at the elbow.

THE INSTRUMENTAL ERROR

From a consideration of the two foregoing parts of this investigation it is clear that the instrumental error on the mean of a sample of significant size is about 5 mm. This is the approximate amount by which two successive determinations of bispinous diameter differ from each other. It is also the approximate amount by which the entire arm length computed from two measurements differs from entire arm length measured directly. When entire arm length is computed from three dimensions the approximate error, as one would expect, is increased to about 10 mm.

SUMMARY

When it can be separated from other observational errors, the instrumental error, due to the direct measurement of dimensions upon the human body, amounts to about 5 mm. in a significant sample; it may of course be much greater in a single determination.

Computed dimensions of bodily parts based upon the summation of directly measured factorial components will be subject to this instrumental error of 5 mm. for each of (n-1) components.

Dimensions of the body based upon the recognition of subcutaneous bony points are not altered by the amount of fluid injected in embalming.

MEASUREMENTS OF THE BRACHIAL AND LUMBO-SACRAL PLEXUSES IN MAN

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INTRODUCTION

In 1850 Kölliker measured the areas of ventral and dorsal roots in the bodies of one man and one woman (5). The measurements were made by computation of the area of a circle from the diameter of the (apparently) fresh root after removal of bloodvessels, arachnoidea and perineurium. The method is rapid and simple but open to objection since nerve roots are not cylindrical and there is considerable connective tissue surrounding and permeating the bundles of nerve fibers. We have also observed that it is very difficult to avoid considerable alteration of the bulk of a nerve root after dissection owing to changes in its water content. Nevertheless the principle of Kölliker's method seemed to me the only practicable one for application to a considerable number of specimens.

Nine years later Stilling also examined the nerve roots from a single female cadaver (9) but used more precise methods. He hardened the roots in chromic acid and cut them by hand with a razor at the point where they penetrate the dura. Projection with a camera lucida gave a number of enlarged drawings of the roots. In one set of observations the areas were measured by a planimeter and in another the paper figures of the sectioned roots were cut out and weighed. The necessary mathematical reductions gave quite comparable results by the two methods.

It is to be noted that the value of both Kölliker's and Stilling's results depends upon the assumption that there is a close and definite relation between area of nerve root and number of its contained fibers, an assumption proved correct by Ingbert in a much more refined and elaborate research (2, 4). Ingbert rightly lays stress upon the errors of Kölliker's

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method induced by considering the nerve roots as perfect cylinders and making no allowance for included connective tissue, but in my opinion he makes a mistake in ignoring the amount of error which inevitably results from dehydration of the nerve root during and immediately after dissection. This source of error Ingbert does not even mention though he does quote Donaldson's work on brain to indicate that fixation of nerve roots by chemical reagents probably results in merely slight shrinkage (1). This observation, though significant, gives no information regarding the really important shrinkage of the nerve root, namely that occurring from loss of moisture once it is laid bare.

In 1911 Wood Jones made scale models of the roots of the brachial plexus to show the relation of size of roots to form of vertebra and development of costal element (11). In this work there was not any effort to eliminate possible errors by taking a significant number of individuals.

The principle of Kölliker's method seemed to me a useful one and apparently capable of extension to a large series like ours. It is true, as Ingbert remarks, that the amount of connective tissue varies considerably in the several nerve roots and that the number of nerve fibers per square millimeter of the cross sections may vary considerably in different fascicles of the same spinal root. In general, according to Ingbert, the dorsal roots of the brachial plexus show less concentration of fibers than the dorsal roots of the lumbo-sacral plexus but the greater number of fibers in the latter largely results from the inclusion of very numerous small fibers. In the dorsal roots of the nerves with which we are concerned the compactness varies from 13800 fibers per square millimeter in S. I. to 9800 in C. VIII. The compactness in the ventral roots of brachial and lumbo-sacral plexuses varies between 4300 fibers per square millimeter in S. I. and 9500 in T. I. This summary of Ingbert's work constitutes a valid theoretic objection to the method we propose to investigate. The second objection is not of real practical importance since the enhanced density is brought about by increase in number of the small fibers. The first objection however has great weight and so has the dehydration already mentioned. Nevertheless we considered that our investigation would not involve enough error from differences in amount of connective tissue to render it invalid and the dehydration, being already appreciated, might be reduced to insignificance. We also proposed to safeguard our calculations from the error induced by regarding nerve roots as cylinders. Should the method prove reliable after critical examination I intended to apply it in routine fashion to all our cadavera and obtain a long series from which I could compute the significance of the relationship between form of vertebra and size of nerve. The present paper embodies the results of our inquiry into the feasibility of the method.

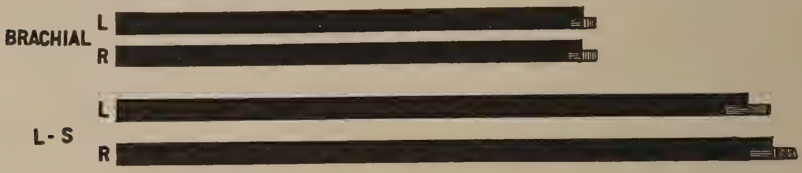
METHOD

A careful dissection of the roots of the brachial and lumbo-sacral plexus on both sides was made by Dr. W. H. McGaw. To do this upon the otherwise untouched cadaver involves an unjustifiable amount of time. Consequently, after a few trials we resolved to use dissecting room material when the ordinary student dissecting had progressed to a suitable point. There are some disadvantages in this resulting from the fact that the average freshman medical student, although he have an arts degree and have had special training in biology, is not to be depended upon, in his first dissection of any part of the body, to make a complete exposure or to note any variation or any deviation from the modal condition. It is necessary to stop him when he comes to the significant stage and to carry out the dissection for him. This we endeavored to do but were not always successful, through pressure of other work, so that sometimes we found the exposure already made. Once the nerve roots are laid bare they quickly dry up and shrink in spite of the elaborate precautions taken in our laboratory against dessication. This perfectly understandable defect in student technique and observation must always be taken into account in reports which depend upon routine observations by the student body.

After Dr. McGaw had made or completed the exposure it was necessary to measure the cross section. This was done immediately beyond the dorsal root ganglion. The composite nerve is oval in cross section and by gentle pressure of a pair of gliding callipers (Gleitzirkel) its two dimensions were read. We tested out our error in this measurement and found it relatively great. It was therefore decided to take the mean value of four observations, two being made by Dr. McGaw and two by myself. Sufficient time and enough other observations were allowed to intervene to render it certain that the observer would not recall the values of his previous measurements. Each time the observations were made the area was calculated and the four values of area were averaged. At this stage Miss W. M. Kuenzel was called in to join us and every computation of area and all averages were checked by two persons.

By the time we had completely covered thirty-one cadavera I halted the work for it was then obvious that the technique does not admit of such accuracy of observation that it can be applied as a routine method in the laboratory.

Of the thirty-one cadavera twenty-one were male Whites. I have used these twenty-one to demonstrate the possibilities and shortcomings of the method. While I accept with reserve the results in individual cadavera especially when considering the relation between composition of the plexuses and formation of the vertebral column I believe it probable that errors will cancel each other sufficiently to permit the use of our averages for a discussion of certain features of the plexuses them selves.



TOTAL ROOT AREA OF PLEXUS MALE WHITE

FIG. 1. Relative total area of limb plexuses in Man (White males). As between White and Negroes there is no racial tendency towards difference in area on the two sides. The greater area of the lumbo-sacral plexus is strictly proportional to the larger number of nerve roots. No effect upon total root area can be discerned in sex or stock.
In this and the following figures the hatched area on each column indicates the size of the probable error of the mean.

TOTAL AREA OF PLEXUSES (Fig. 1.).

Our complete series comprises: male White 21, female White 3, male Negro 5, female Negro 2. This complete series is termed our general population in distinction to the male Whites alone. The average total root areas in general population and in male Whites are given in Table I.

TABLE I. AREAS OF NERVE ROOTS. TOTAL OF PLEXUS.

	Mean of brachial plexus	
	Gen. pop. (31)	White male (21)
Right	42.48	41.53
Left	41.56	41.75
	Mean of lumbo-sacral plexus	
Right	59.21	58.50
Left	58.34	56.26

Standard deviations and errors of the mean have been calculated for male Whites only and they appear in Tables VI, VII, VIII, but from a consideration of these in the male White it is apparent that there is no significant difference in the mean areas of the plexuses when sex and Stock are segregated. In the ultimate analysis root area depends upon number of constituent fibers and hence our results indicate that sex and Stock bear no relation to number of axons.

This conclusion is diametrically opposed to that attained by Ingbert so that some fuller discussion is called for. Table II gives a resumé of the areas quoted by all the authors together with the averages for limb plexuses found in the present investigation. It is apparent that Kölliker's method, which of all those mentioned is most closely resembled by our technique, gives a result most closely comparable with ours. Allowing for the nerves not measured by us it is apparent that the result is approximately the same.

TABLE II. CROSS SECTIONAL AREAS OF NERVE ROOTS.

	Kölliker male	Kölliker female	Stilling female	Ingbert male
Total left dorsal roots	79.74	68.40	59.95	54.93
Total left ventral roots	34.51	33.48	35.23	26.50
Total ventral and dorsal	114.25	101.88	93.18	81.43
Average total left brachial plexus (T. W. T.)				41.75
Average total left lumbo-sacral plexus (T. W. T.)				56.26
Total limb plexuses				98.01

TABLE III.

Computed by Ingbert from his own results together with those of Kölliker and Stilling (4, p. 232).

(a) Relation of the area of the cross-sections of four roots of the brachial plexuses

	2 males	2 females
Ventral (C. V–VIII)	16.38 mm²	16.02 mm²
Dorsal (C. V–VIII)	40.04 mm²	21.30 mm²
	56.42 mm²	37.32 mm²

(b) Relation of the area of the cross-sections of four roots of the lumbo-sacral plexuses.

	2 males	2 females
Ventral (L. IV, V and SI, II)	14.36 mm²	17.46 mm²
Dorsal (L. IV, V and SI, II)	31.04 mm²	33.24 mm²
	45.40 mm²	50.70 mm²

Adding together the values for the roots of four nerves of the brachial plexus given in the combined researches of himself, Kölliker and Stilling, Ingbert obtained the figures quoted in Table IIIa. By the same method he derived the comparable figures for the lumbo-sacral plexus set down in Table IIIb. From the equivocal results given thus hap-hazard Ingbert concludes that there is a sex difference, that "males have a little better motor and much better sensory innervation for the arm," and "females have a better motor and sensory innervation of the hips and legs." Surely such inferences border on the grotesque but, giving serious consideration to the figures upon which they are based, let us see what relation these figures bear to the results of our own work.

Table IV presents the average values for the corresponding nerves in the present series. The male values are the average of twenty-one subjects, the female values of only three. Kölliker's values for one male White subject are C. V-VIII 30.86 mm²; L. IV, V. S. I, II 27.86 mm². The disparity between the results in Tables III and IV is therefore mainly due to difference in technique between Ingbert and ourselves.

TABLE IV. CROSS SECTION AREAS OF PARTICULAR NERVE TRUNKS (FOR COMPARISON WITH TABLE III).

Average aggregate cross sectional area of four roots of the brachial plexus

	21 White males	3 White females
C. V–VIII	33.68 mm²	34.46 mm²

Average aggregate cross sectional area of four roots of the lumbo-sacral plexus

	21 White males	3 White females
L. IV, V. SI, II	38.88 mm²	42.93 mm²

TABLE V. AVERAGE CROSS-SECTIONAL AREAS OF NERVE TRUNKS AND PLEXUSES.

		White		Negro	
		Male (21)	Female (3)	Male (5)	Female (2)
Total Brachial left		41.75	38.21	44.73	36.65
Total Brachial right		41.53	42.87	49.27	34.86
Total Lumbo-sacral left		56.26	59.93	69.30	50.41
Total lumbo-sacral right		58.50	62.93	65.79	44.62
Brachial Plexus left	C5	4.07	3.67	4.57	4.45
	C6	7.21	7.05	8.71	6.28
	C7	11.76	12.32	10.98	9.08
	C8	10.64	8.88	10.57	10.58
	T1	7.06	6.30	7.90	6.26
Brachial Plexus right	C5	4.15	4.06	4.73	3.65
	C6	7.99	8.75	9.23	5.78
	C7	12.05	14.09	12.01	8.14
	C8	9.96	9.91	16.09	11.92
	T1	6.71	5.86	7.20	5.38
Lumbo-sacral Plexus left	L2	5.78	4.29	5.65	3.34
	L3	7.58	10.55	7.66	5.74
	L4	8.90	11.13	11.09	8.42
	L5	10.50	10.32	13.65	10.46
	S1	12.36	12.79	17.29	10.86
	S2	7.12	7.50	9.23	8.30
	S3	2.56	2.54	3.75	3.14
Lumbo-sacral Plexus right	L2	5.90	4.56	5.79	2.92
	L3	8.42	10.18	7.35	3.69
	L4	10.10	10.93	10.39	6.61
	L5	11.76	13.45	13.19	10.58
	S1	11.63	11.90	16.31	10.33
	S2	6.66	7.89	9.25	7.78
	S3	2.43	2.93	3.23	2.72

Table V illustrates our contention that in area of nerve trunk there is no real difference correlated with sex or Stock. The probable errors and variabilities in Tables VI, VII, VIII, permit this conclusion without further demonstration.

It is also apparent that there is no real difference between right and left sides. Although we have no observations bearing upon right or left-handedness the majority of these individuals may safely be presumed to be right-handed. Hence dexterity and delicacy of movements and of control seem to be unrelated to number of axons.

The total area of the plexus depends in part directly upon the number of nerves involved. The average total area for the male White brachial plexus with five component nerve roots is 41.6 sq. mm., and for the male White lumbo-sacral plexus with seven roots is 57.4 sq. mm. By calculation the average lumbo-sacral area should be 58.3 sq. mm. So small a difference between actual and calculated area is negligible.

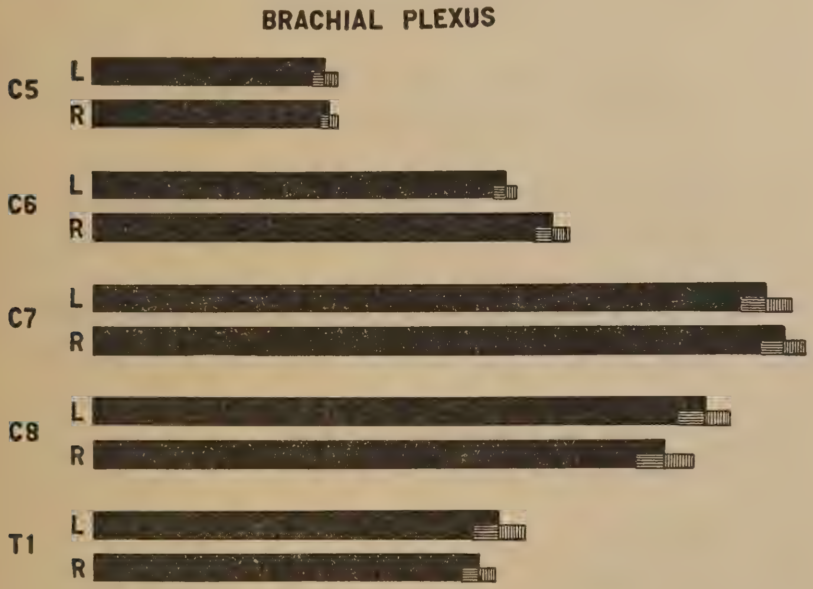


FIG. 2. Graphic representations of brachial plexus in White males. The root area is bilaterally symmetrical and the slight prefixation of the right plexus in the graph is merely accidental: it results from random sampling.

THE NERVE ROOTS (Figs. 2 and 3).

In this article we have already pointed out that the total area of the plexus in Man varies directly with the number of constituent nerve roots. Figures 2 and 3 illustrate graphically the symmetry of the brachial and lumbo-sacral plexuses. Each column has depicted upon it the probable error. Hence the difference between the averages for right and left sides is not assumed to be absolute but is corrected by the magnitude of the probable error. The extreme column length in both figures is approximately the same, indicating of course that the maximum nerve root area is the same in both plexuses. Tables VII and VIII show this

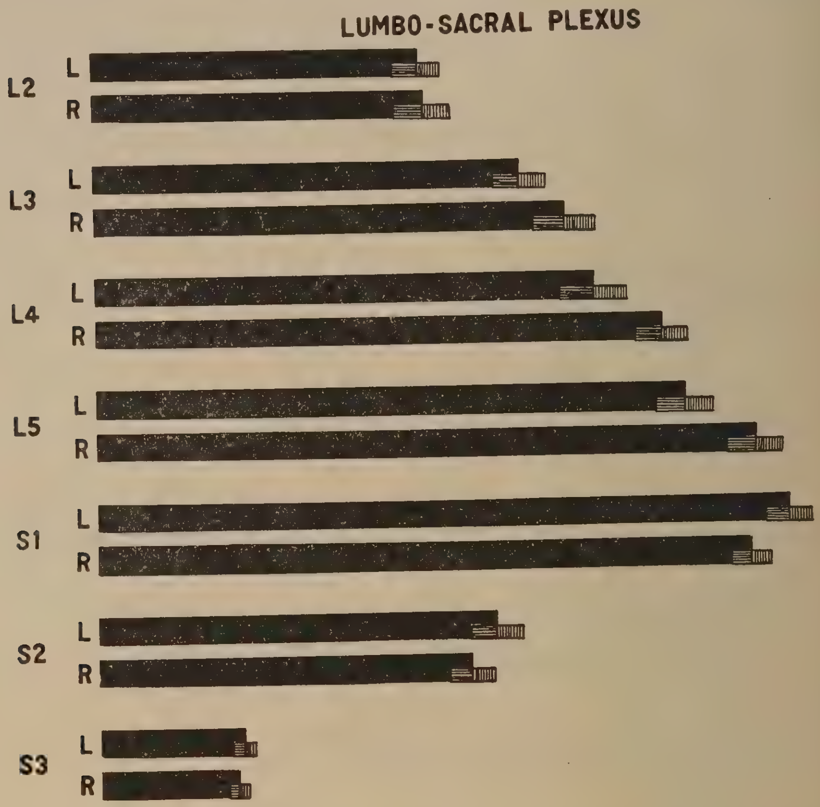


Fig. 3. Graphic representations of lumbo-sacral plexus in White males. The root area is bilaterally symmetrical. Maximal root area is the same as in the brachial plexus. The prefixation of the right plexus in the graph is merely accidental as in Fig. 2.

Table VI. 21 White Male Plexuses.

	Mean area	S. D.	C. of V.
Total brachial left	41.75±1.184	8.05±0.838	19.28
Total brachial right	41.53±1.276	8.67±0.902	20.88
Total lumbo-sacral left	56.26±2.125	14.44±1.503	25.66
Total lumbo-sacral right	58.50±2.134	14.50±1.509	24.80

Table VII. 21 White Male Plexuses.

		Mean area	S. D.	C. of V.
Brachial plexus left........	C5	4.07±0.232	1.58±0.164	38.82
	C6	7.21±0.216	1.47±0.153	20.39
	C7	11.76±0.455	3.09±0.322	26.28
	C8	10.64±0.466	3.17±0.330	29.79
	T1	7.06±0.436	2.96±0.308	41.92
Brachial plexus right.......	C5	4.15±0.146	0.99±0.103	23.86
	C6	7.99±0.257	1.75±0.182	21.90
	C7	12.05±0.403	2.74±0.285	22.74
	C8	9.96±0.499	3.39±0.353	34.04
	T1	6.71±0.283	1.92±0.200	28.61

Table VIII. 21 White Male Plexuses.

		Mean area	S. D.	C. of V.
Lumbo-sacral plexus left........	L2	5.78±0.405	2.75±0.286	47.58
	L3	7.58±0.462	3.14±0.327	41.42
	L4	8.90±0.587	3.99±0.415	44.83
	L5	10.50±0.528	3.59±0.374	34.19
	S1	12.36±0.424	2.88±0.300	23.30
	S2	7.12±0.474	3.22±0.335	45.22
	S3	2.56±0.178	1.21±0.126	47.27
Lumbo-sacral plexus right.......	L2	5.90±0.506	3.44±0.358	58.30
	L3	8.42±0.562	3.82±0.397	45.37
	L4	10.10±0.466	3.17±0.330	31.38
	L5	11.76±0.514	3.49±0.363	29.68
	S1	11.63±0.375	2.55±0.265	21.93
	S2	6.66±0.399	2.71±0.282	40.69
	S3	2.43±0.169	1.15±0.120	47.32

equally plainly. The central nerve of the brachial plexus, C7, has a cross sectional area of 11.76 and 12.05 sq. mm. on left and right sides respectively. In the lumbo-sacral plexus the corresponding values for L5 are 10.50 and 11.76; those of S1 are 12.36 and 11.63. It is a point worth noting that the divergence in size which has developed in the limbs of Man is not enough to alter the primitive character of equality in area of nerve roots.

According to the figures the higher roots of both plexuses are absolutely larger on the right side and the distal roots absolutely smaller, that is to say there seems to be a tendency towards prefixation on the right side in brachial and lumbo-sacral plexuses alike. It is certainly striking that both figures should indicate the same thing but if one examine the probable errors of the mean values it is apparent that this bias towards prefixation on the right is unproven. I do not say that it may not be so; I do insist that until evidence is brought to demonstrate clearly that the apparent tendency is considerably greater in value than the probable error of the mean it should receive no emphasis.

In furtherance of this contention I have calculated the chances of a real difference between the means of right and left sides in two nerve roots namely C. VIII and L. V. There is no need here to go into detail concerning the technique of this computation which is sufficiently demonstrated on pp. xvii, xviii of Pearson's Tables for Statisticians and Biometricians (8). The chances that the difference between the mean values represents a real difference in conformation of the roots on right and left sides of the body, that is prefixation on one or other side, are for C. VIII, 1 to 1, and for L. V. 3 to 1. But mathematically we cannot assume a real distinction unless the chances are 199 to 1 (7). Therefore, upon the evidence before us, we must conclude that statements to the effect that there is a tendency in human plexus formation towards prefixation on one or other side are premature if not actually erroneous.

VARIABILITY AND PROBABLE ERRORS

The probable errors of the mean in Tables VI, VII, VIII give a very definite indication of the reliability of the method chosen and the usefulness of absolute values for individual cases. Elsewhere I have discussed the problem of the coefficient of variation as applied to human physical investigation (10) and I have stated my conviction that when this coefficient approaches twenty per cent there is present some factor which renders it necessary to use extreme caution in interpreting the results. At the time this contention was not sufficiently clearly explained. Since then however an excellent short note by Miner (6) has demonstrated the method of argument and renders further discussion unnecessary. Frequently the factor to which I have just referred is related to method, either to a flaw in technique or to some characteristic of the material employed which stultifies accuracy of measurement. The largest coefficients of variation in the present investigation are to be found in the small roots at the limits of the plexuses. I do not interpret this fact as evidence of greater variability but as a very definite indication of technical error caused through small size of the roots and difficulty of cleaning. On the other hand the consistently greater coefficients for the lumbo-sacral plexus do at least suggest that variability in the plexus is really greater than in the brachial. This may be associated with the variability in bulk of the lower limbs.

In the previous chapter I have demonstrated that, as yet, there is no reason to assume any real difference in root areas on the two sides of the body. It is true that the difference between right and left means of some nerve roots is greater than the probable error of the means but by so little that the difference is insignificant in relation to the probable error of the difference which I have not thought it worth while to set down.

With so great a coefficient of variation that the calculation of its probable error is uncalled for, it is obvious that these results should be applied to individual cases only with the utmost reserve. Indeed it is doubtful, considering the great amount of work involved, whether safe conclusions could be drawn in particular instances, in estimation of area of root from vertebral characters. We propose, naturally, to investigate the relation between root area and vertebral features in the twenty-one male White subjects which we have used as a sample but the outcome of this work must be left for a later report.

SUMMARY

1. Investigation of the cross-section area of nerve roots of brachial and lumbo-sacral plexuses by gross measurement in a sample of our male White dissecting room population, even though safeguarded as well as the method permits, seems to be useful simply as a means of obtaining the average absolute root area. This is of value just as the running average or trend is of value in demonstrating the standard pattern of suture closure, but it is not thereby to be inferred that the method can be safely utilised for critical investigation of particular cases.

2. The investigation shows that there is very great individual variability in the gross area of each nerve-root and this is complicated by difficulties in the technique.

3. We find no real tendency in any nerve root to greater size on one side of the body and it does not seem that right- or left-handedness has any influence upon the area of the roots.

4. We can discover no real tendency to prefixation of either brachial or lumbo-sacral plexus on right or left side.

5. There is apparently a maximal cross-sectional area for nerve roots which is the same for both plexuses in Man. The difference in bulk of upper and lower limbs is not sufficient to influence size of root.

REFERENCES

1. Donaldson, (H. H.)—1894. Preliminary observations on some changes caused in the nervous tissues by reagents commonly employed to harden them. *J. Morph.*, IX, 123–166.
2. Ingbert, (C. E.)—1903. An enumeration of the medullated nerve fibers in the dorsal roots of the spinal nerves in Man. *J. Comp. Neur.*, XIII, 53–120.
3. Ingbert, (C. E.)—1903. On the density of the cutaneous innervation in Man. *J. Comp. Neur.*, XIII, 209–222.
4. Ingbert, (C. E.)—1904. An enumeration of the medullated nerve fibers in the ventral roots of the spinal nerves of Man. *J. Comp. Neur.*, XIV, 209–270.

5. Kölliker, (A.)—1850. (See Ingbert 2, 4). Microscopische Anatomie, Leipzig, 433–4.
6. Miner, (J. R.)—1924. The variability of skull capacity. *Am. J. Phys. Anthrop.*, VII, 425–6.
7. Pearl, (R.)—1924. Medical Biometry and Statistics, 8°, Phila., 258.
8. Pearson, (K.)—1914. Tables for Statisticians and Biometricians, p. xvii.
9. Stilling, (B.)—1859. Neue Untersuchungen über den Bau des Rückenmarks. Cassel, 346 (See Ingbert 2, 4).
10. Todd, (T. W.)—1924. Thickness of the male White cranium. *Anat. Rec.*, XXVII, 245–256.
11. Wood Jones, (F.)—1911. Variations of the first rib, associated with changes in the constitution of the brachial plexus. *J. Anat. & Physiol.*, XLV, 249–255.

NON-CHINESE INHABITANTS OF THE PROVINCE OF KANSU, CHINA

FREDERICK R. WULSIN

The paper published below constitutes the anthropological section of the Report for 1923 of the National Geographic Society Central China Expedition. Thanks are due to the President of the National Geographic Society for permission to publish it.

In this chapter of my report I have attempted to make a list of the non-Chinese peoples which inhabit the province of Kansu, and to present the observations on them which we ourselves made. To investigate the history of these populations is a very large task, demanding ample leisure for the study of Chinese historical literature. I have made no attempt to go into this part of the subject, beyond mentioning a few stories that are generally accepted. Needless to say, such stories must be received with caution.

Topography.—The present population of Kansu is mixed and composite, the result of many wars and migrations. One cannot understand its distribution without first forming a clear idea of the topography of the region it inhabits. Kansu lies at the extreme northwestern corner of China proper. It is bounded on south and east by Chinese provinces. On the west it touches the Kokonor territory of Tibet, and on the north Mongolia. Chinese, Mongols and Tibetans have met, fought and settled again and again in the province. Other strains, less numerous, have come from Chinese Turkestan, many days to the westward.

Eastern and central Kansu is a mountainous region of loess, whose altitude runs from four to six thousand feet. It is inhabited by Chinese, most of them descendants of immigrants from provinces further eastward, with a scattering of small Moslem communities here and there. Further west the altitude increases gradually until, in the neighborhood of Lake Kokonor, it reaches 10,000 feet, and one is on the rolling grass lands of northeastern Tibet. This is a region ill suited to agriculture, inhabited by nomad Tibetans. The intermediate country, like most border lands, has seen many bloody struggles. Today it contains Chinese, Tibetans and Moslems. High rolling grass land extends southeast from Lake Kokonor towards Old Taochow, to be lost in the Min Shan range, which encloses Kansu on the south. This range of mountains is steep and wild, wooded in parts, and inhabited by agricultural Tibetan tribes of whom little is known. Running from west to east, it forms the natural boundary between Kansu and Szechuan.

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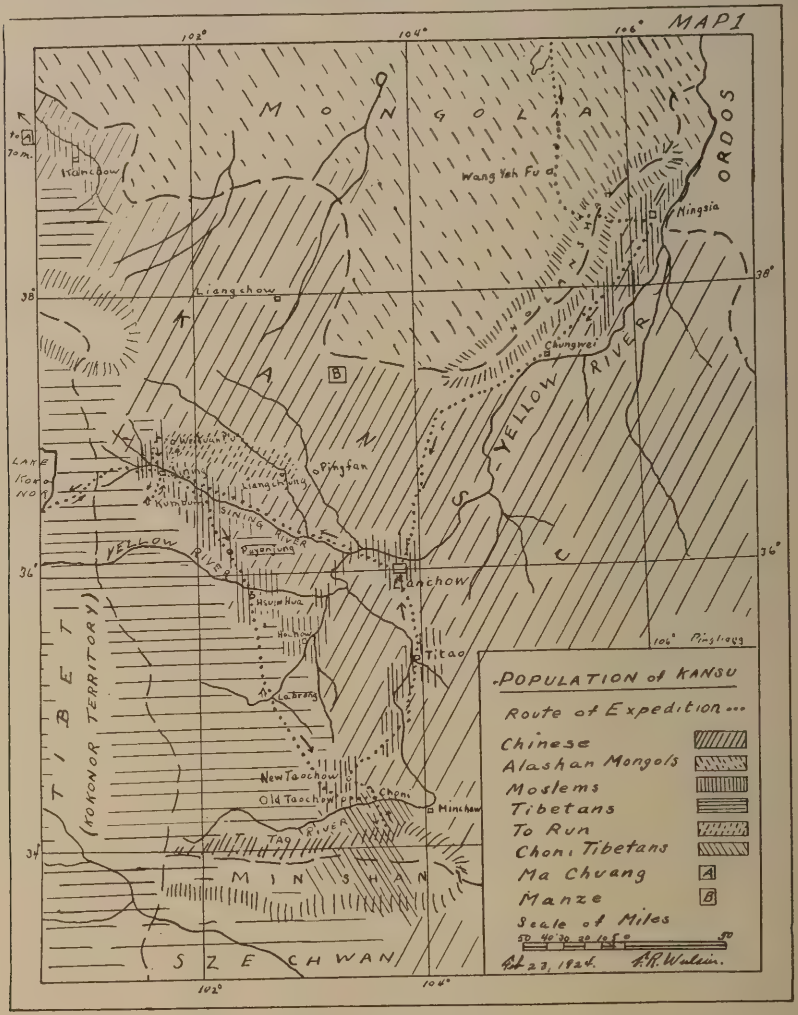
From the Min Shan northward the land slopes down until the Yellow River in central Kansu is reached. The intervening country is rough and diversified, inhabited by a mixed farming population.

North of Central Kansu lies the Alashan desert, which eventually merges in the Gobi. It is of moderate altitude, inhabited by nomad Mongols. Eastward the Holanshan mountains cut it off from the Yellow River. To the west lies a line of oases and cities running northwestward, which form the highway from China into Turkestan. South



of this extension of the corner of Kansu rises the Richthofen range, which here marks the edge of the high Kokonor country.

The Yellow River drains most of the province. It comes into Kansu from the west and leaves at the northeastern corner. The Alashan desert and the Kokonor basin have internal drainage.

Population.—It is difficult to distinguish races in China, but it is easy to distinguish nationalities. The former are determined by blood; the latter by language, costume, dwelling, mode of life, religion, political party, taxation and residence. In studying the people of Kansu, I have been forced to classify them by that which is obvious and unmistakable, not by that which is uncertain and hidden.

I have tried to describe the salient physical characteristics of each tribe or group. There are, however, great individual variations. For instance, the infant son of the regent of Alashan has blonde hair and a white skin. His official father looks like a Chinese gentleman, with an unusually aquiline nose, black hair and a yellow skin. The son might be a Russian baby. We know that that particular family has a good deal of Manchu blood in it; from the appearance of this youngster it is probable that there is Russian blood also. The skin of the sedentary Tibetans is dark brown, about the color of a cigar. Occasionally one sees an individual whose skin is distinctly lighter and looks quite yellow at a distance. Such an individual, if a young woman, is very likely to be much prettier in features than those around her, though she will show the same physical characteristics—a very straight, spare figure, broad shoulders, slender hips and muscular arms. I have seen several Tibetans with distinctly curly hair, sometimes of a black which was rusty, not glossy. I have also seen Chinese whose hair was rusty brown, or even a dirty, sandy yellow, and sometimes wavy also.[1]

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[1] There is a general impression that Chinese hair is always black and always perfectly straight. I cannot agree with these statements. Chinese hair dressing is unfavorable to correct observations: the Chinese woman makes it a point to plaster down her hair with cosmetics and to arrange it in a very formal manner, according to well established fashion, doing her best to conceal any waviness or curl that the hair may possess; and Chinese men in former times shaved the front of the head and braided what remained in a queue. The weight of the queue helped to keep the hair straight and any curl which it had was effectually concealed. Nowadays most Chinese men shave the whole head, letting the hair grow perhaps a quarter of an inch long before it is shaved again. This treatment reduces it eventually to the state of a scrubbing brush. Again, any natural curl is effectually concealed. There are times, however, when through long journeys, isolated residence or general slovenliness, the normal fashions fail to be observed. Then one sometimes sees hair that is quite wavy. Dusty red beards are occasionally met with. These departures from the

These non-black hair colors are not the clear blonde or clear brown which one finds in Europeans, with the single exception of the son of the regent of Alashan. The color is rusty and dusty, as if the hair had tried to be black and had not succeeded. I have seen one farmer in Shansi who had fine grey eyes and features which might have come from the Kentucky mountains. This man stood at least 6 feet 2½ inches. The rather flat Chinese nose is usual among the Chinese of Kansu, but by no means universal—even less common than it is in most of China proper. It may be replaced by a somewhat long, aquiline nose, with a low bridge, or, if there is a Moslem strain, by a nose distinctly Semitic. The so-called Greek nose alone is conspicuous by its absence.

Direct observations were made on the following non-Chinese groups:

1. *The Alashan Mongols*, who inhabit the desert north of Kansu.
2. *The Moslems*, whose stronghold is western Kansu, from Sining to Hochow and Taochow.
3. *The Tibetans*, nomad and sedentary, who inhabit the Kokonor territory and the grassy highlands and adjacent valleys which compose the southwestern part of Kansu proper as shown on the maps.
4. *The To Run*[2] or "earth men," sometimes called aborigines, who inhabit a somewhat wooded region north of the Sining River, between Liang Cheng and Sining, in western Kansu.
5. The so-called *Choni Tibetans*, who inhabit the Min Shan range on the southern border of Kansu and who have their capital at Choni on the Tao River.

A few notes were gathered from missionaries on other non-Chinese inhabitants of the province, as follows:

6. *The people of Ma Chuang*, between Kanchow and Suchow.
7. The *Manze*, southeast of Liangchow.

There are probably other small groups who differ from the populations which surround them[3]. The information at hand is too scanty to justify me in listing them here.

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ordinary straight black hair of the Chinese are more common in Kansu and Inner Mongolia than in old settled provinces. The pilosity also seems to increase as one goes westward. Respectable beards are seen more and more often. The fact that these phenomena often go together and appear in a larger number of individuals, rather than to a greater degree in all individuals, would point to a mixture of races as the probable cause.

[2] To Ten in the Wade system of transliteration.

[3] North of New Taochow and south of the great Lean Hua mountain, one passes through many villages which suggest mixed Chinese and Tibetan influences. Wild rock dwelling men are said to exist in the mountains off the road between Minchow and Titao. Monkeys, bears or fugitives from justice may have given rise to the rumor.

THE ALASHAN MONGOLS

The Alashan Mongols inhabit the desert north of Kansu proper. Their territory is bounded on the south by the outer loop of the Great Wall and on the east by the Holanshan mountains. They lay claim in a legal way to the town of Tengkow on the Yellow River, but the town is administered by Chinese officials. The regent of Alashan could give me no definite information about the northern frontier. It lies near latitude 42° N, in the desert. Beyond it comes Outer Mongolia, ruled from Urga. On the west, Alashan is bounded by the Edsin Gol, a small river running from the Richthofen range to the desert in longitude 99° to 101°. Almost all of the region described is sandy or stony desert, with a considerable number of wells and sparse vegetation. The whole area is inhabited by nomad Mongols. There is only one city besides Tengkow, which has been referred to above; that is Wang Yeh Fu, the capital of the kingdom, which lies in latitude 39° 6′ N, and longitude 105° 40′ E of Greenwich.

Wang Yeh Fu is a small walled town, founded about 1700, with a mixed population of Mongols, Manchus and Chinese. It contains a lama monastery of moderate size, and two larger ones exist in the valleys of the Holanshan within 20 or 30 miles of the capital. The Manchu element in the population came partly as an escort for the niece of the Manchu Emperor K'ang Hsi, who was given in marriage to a son of the King of Alashan. The Chinese element, as everywhere on China's borders, is composed of those who have found conditions too difficult in their native place and have migrated to make a living. Most of the woodcutters who work in the Holanshan mountains come from Szechuan. The gardeners, storekeepers and artizans of Wang Yeh Fu are chiefly from Cheng Fan Hsien, which lies in Kansu, west of Alashan across the desert. Some Chinese come to Alashan from Ningsiafu, the nearest Chinese city. The population of Wang Yeh Fu may be between three and eight thousand, that of the whole country between forty and a hundred thousand. The country population is Mongol.

The foundation of the kingdom of Alashan runs back to the wars of the Eleuth Mongols under Galdan against the Kholkoit Mongols. The Kholkoits lived in northeastern Tibet near Lake Kokonor. They were defeated and forced to migrate about 1760. By consent of the Chinese Emperor, they made their new home in the present territory of Alashan. En route, or later, they picked up a few Mongol Moslems, who now live in the northeastern part of Alashan.

In theory, the present government is a monarchy under the old

Mongol laws. The king, an intelligent Chinese gentleman, derives great revenue from the export of salt from large deposits which exist within the kingdom. He lives in Peking and leaves the administration of office to his brother as regent. Practically, Alashan is sharing the fate of the other principalities of Inner Mongolia. Chinese settlers are gradually taking up any land which is suitable for agriculture and Chinese influence is becoming more and more powerful. The real power lies with the nearest Chinese magistrate, however subordinate, rather than with the native sovereign. It is evident that sooner or later all but the most arid regions of Inner Mongolia will be transformed into Chinese *hsiens*.

Physically, the Alashan Mongols[4] do not differ noticeably from other Mongols. The stature is short, the figure thick set, the face round and weather beaten. The skin of the Mongol is browner than that of the Chinese, and I am inclined to believe that this is a genuine physical characteristic, not due entirely to dirt and exposure. The eyes are dark brown, the hair is black and straight, rarely long.[5]

The Alashan Mongols are, as a rule, well formed and healthy. Their pastoral life is full of hardships, and diseases are quickly cured or are fatal. A good many have had small pox. The country Mongol is not lean and spare like the Tibetan, but solid and muscular in build. Lamas, who lead a sedentary life in the temples, are often quite stout in middle age. The carriage of the Mongol nomads is difficult to describe. It is neither the regal walk of the Tibetan woman, nor the swift, almost athletic walk of the Chinese mule driver; it more closely resembles that of a football player in hobnailed shoes, the shoulders somewhat forward and the feet set down as stumps. This is probably due to the enormous boots with flat, stiff soles that the Mongols wear, and to their early habit of horsemanship. Of the two, I should say that the boots were the more important.

I have no means of estimating the acuteness of the senses of the Alashan Mongols. As all over China, cataract is common. The Mongol seems thoroughly stupid. One guide we had was unable to count money, and the idea of time is totally foreign to Mongol minds. Any Chinese coolie who has traveled seems a scholar and a philosopher by comparison with the wandering Mongol. The lamas who live in temples and read Tibetan are of course much clearer headed in answering questions; and yet even they run behind the Chinese of corresponding station.

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[4] I am leaving the royal family and the richer townspeople out of account in this description, because they have intermarried much with Chinese and Manchus.

[5] Mr. Wu Tze Pin points out that the hair of the Mongols never grows very long, perhaps because it is much neglected. The great horns worn by women near Urga are made by filling the hair with glue and letting it dry in shape. Even when these horns are not worn, as in Alashan, the hair is combed and washed infrequently.

The town-dwelling Mongols of Alashan are relatively rich and civilized, and have constant intercourse with Chinese and Manchus. The well-to-do among them are extremely lazy. They let Chinese do their working and trading. They may take part in the government administration, or go once in a while on a journey. Their customs are not distinctively Mongol, but are rather a localized form of general Chinese customs. Their tastes remain Mongol; witness their intense interest in firearms and horses.

In culture the pastoral nomads of Alashan do not differ from those who have been described so often in other parts of Mongolia. Their food supply, their customs, their tents and their beasts are the same. Their costume differs only in minor details. One sees hats of different fashion in different parts of the country, and some of them are shown in the photographs taken by the expedition. To distinguish them by tribe and place would demand prolonged study and a good knowledge of the Mongol language.

The Mongol language[6] as spoken in Alashan resembles the Urga dialect very closely. It differs considerably from the dialect used in Eastern Inner Mongolia. The Wulashan dialect differs slightly from the Alashan dialect; Wulashan lies immediately east of Alashan, north of the Yellow River.

THE MOSLEMS

Moslem settlements are found in several parts of Kansu, notably in the region of Ningsiafu in the northeastern corner of the province, and in the regions of Sining, Hochow and Taochow in the west and southwest. These are the strongest Moslem communities. Smaller settlements are found scattered in almost every part of the province. The Moslems are farmers, traders, artisans, boatmen and soldiers. In Chinese they are known as *Hui Hui* "returners". The best judges estimate their numbers as three million, one-third of the total population.

From their first appearance in Kansu the Moslems have shown unusual enterprise, cohesiveness, *esprit de corps* and ability to fight.

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[6] My information on the Alashan dialect, and on many other Mongolian subjects came from or is confirmed by Mr. Wu Tze Pin, the field manager of the expedition. Mr. Wu spent a number of years in Urga as a Chinese military official, and has traveled widely in Eastern Mongolia.

These characteristics have brought them much power. As in other parts of the world, so here: they are Moslems first and dwellers in the locality afterwards.

The Mohammedans of Kansu are commonly divided into three groups of different ancestry.[7] These groups[8] are as follows:

1. The Arab Hui Hui, known in Chinese history as the Ta Shih Hui Hui.
2. The Turkish Hui Hui, known as the Salar.
3. The Mongol Hui Hui, including a branch of the Ouigurs known as the Huihuh, and a Tartar tribe known as the Wei Wu-Er.

According to legend, the Arab Hui Hui are descended from small bodies of Arabs who migrated across Turkestan to China before the year 1000 A. D. The Salars, or Turkish Hui Hui, came later. There is reason to believe that their previous residence had been in Western Turkestan.[9] The Huihuh, or Ouigurs, were converted to Islam while living in Chinese Turkestan near Turfan and Hami. The Wei Wu-Er adopted Islam while living somewhere near the present province of Kansu. They still speak a peculiar Mongol dialect.

The great Moslem rebellions of 1862 and 1895 began through Chinese interference in Moslem sectarian quarrels. They resulted in the devastation of large areas and the slaughter of very considerable numbers of peaceful inhabitants on both sides. Each rebellion was settled by a compromise between the Chinese authorities and the rebel leaders. Today Moslems hold most of the high military posts in the province, but they have not yet succeeded in establishing a Moslem governor. Their power, which is quite out of proportion to their numbers, is due entirely to their courage, their enterprise, their willingness to fight and their obedience to their leaders. They are probably the best military material to be found in the length and breadth of China. Political tension, with the constant possibility of further civil wars, keeps up their martial spirit.

The individual Moslems that one meets show much physical diversity. Some cannot be distinguished from ordinary Chinese except by the way they cut their moustaches. Others are quite distinct from the Chinese in appearance. Near Ningsia and Lanchow one sees many tall

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[7] The literature on this subject, principally in Chinese is enormous. To investigate it is beyond the scope of this paper. I have given this short summary because the names given to the Hui Hui are unintelligible except in the light of commonly accepted stories of their origin.

[8] I am indebted to the Rev. G. Findlay Andrew for this classification.

[9] According to the Rev. G. F. Andrew, who knows the Kansu Moslems well, the Salar women to this day retain the Samarkand style of dress.

Moslems, standing from 5 ft. 7 in. to 5 ft. 11 in. They are spare, long limbed and active. The forehead is high, the face long, and the nose well developed and aquiline, the eye horizontal and large. I cannot say whether the Mongol eye fold is always present. The beard is abundant, though never as great as in the European. Men like this are spoken of as Arab Hui Hui. I have seen individuals exactly like them in a notoriously Salar village. Other Salars who have worked for me as boatmen were indistinguishable from the Chinese of Kansu. We had no opportunity to observe the Mongol Hui Hui, as distinguished from others of the same religion.

The Moslems live and dress much as the Chinese do. The feet of their women are not always bound. The women go unveiled, though in the Sining region I have occasionally seen a veil, and in riding through a Salar village just east of Hsun Hua, I have glimpsed women's wedding costumes which were certainly not Chinese.

The Moslems enter practically every occupation, and almost completely monopolize a few. They are pre-eminent as horse traders, soldiers, millers, grain traders and raft men on the Yellow River. This last occupation is almost a Salar monopoly. They will not eat pork or meat improperly killed. In dwellings, dress, industries, methods of agriculture, etc., they do not differ from the Chinese who surround them, except as the Koran may dictate peculiarities. Mosques are built in the Chinese style, but with towers as minarets. The weapons most used are modern rifles smuggled up from Hankow. The Moslems are better armed than other sections of the population, and will pay almost anything for a fine weapon.

Both Chinese and Mohammedan laws permit polygamy, but it is unusual in Kansu for economic reasons. Hui Hui families must be large, for the Mohammedan population has recuperated rapidly after each rebellion. In 1896, 10,000 Moslems were slaughtered in the suburbs of Sining alone. Today the Moslems of Sining are as strong and apparently as numerous as ever.

The Hui Hui are said to possess unusual strength and endurance. I have seen less diseased and defective persons among them than among other peoples of Kansu. It is said also that infant mortality is less among the Moslems than among the Chinese; the explanation given is that the Moslem diet, which includes a good deal of mutton and milk, is better for nursing mothers than the Chinese diet of grain and vegetables with a little pork fat. I was not able to make any direct observations on the subject. The children are educated at the mosques.

The Kansu Moslems are deep in provincial politics. Though they are administered in the usual Chinese way, it is largely by officials of their own faith. They have no secret societies, but they act as a great non-secret society which centers around the mosque. They are much given to crimes of violence and stabbing affrays are frequent, particularly between the Moslems and the Chinese. In parts of the Hochow district robbery and burglary rise to the dignity of a profession. The Kansu Mohammedans are famous for cohesion and for obedience to their leaders, yet minor prophets are constantly appearing and sectarian quarrels are numerous and violent.

The Moslems generally speak Chinese as their native tongue. The Ahongs or learned ones are supposed to read Arabic, but their scholarship is very limited. The Salar, who live on the upper course of the Yellow River near Hsun Hua, speak their own language, a Turkish dialect. This, and the Mongol of a few Mongol tribes, are as far as I know the only non-Chinese languages used by the Moslems.

THE TIBETANS OF WESTERN KANSU

Tibetans are found north, west and south of Lake Kokonor, and west of a line drawn from Hsun Hua to Taochow, old city. They occupy a considerable region which is shown on the maps in current use as part of Kansu proper.[10] Map 1 shows their relation to the other inhabitants of the province.

The Kokonor region is a well watered rolling grassy upland, lying above 10,000 feet. One's prevailing impression in summer is of rounded mountains covered with rich green grass. Trees are rare and small. The summer rainfall is abundant. Though the noonday sun is hot, the nights are cold, even in August, and penetrating winds often blow. The winter is dry and very cold. East of the Kokonor the land shelves down into Kansu with sharper relief. Between Sining and Labrang the valleys are at about 7,000 feet and the summits at 11,000. There are woods on many mountain slopes, and farming villages in the valleys. Tongues of high grass land lie between lower and more sheltered regions. Still further east and still lower down the loess mountains of Kansu begin.

The people described in these paragraphs are those who live between Lake Kokonor and Taochow, Old City. The people who live south and east of Old Taochow will be discussed under "Choni Tibetans." No observations were made on the people who live west and north of Lake Kokonor. Within the region so marked off, country south of the Yellow River is covered in more detail than country north of it.

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[10] In some districts, notably those of Pai Yen Jung and Hsun Hua, the population is exceedingly mixed. There are Moslem villages, Tibetan villages, Chinese villages and Tibetan nomad encampments within a few miles of each other, all perfectly distinct.

Tibetans have dwelt here for a very long time. Chinese literature contains early references to shepherd tribes in the Kokonor region. Though in no way immune to conquests and wars, the population seems to have been successful in maintaining its identity. This may be because the altitude and the cold of the plateaux render them unattractive to other peoples.[11]

The division between nomad and sedentary population seems to be largely a matter of altitude. Above 10,000 feet agriculture becomes exceedingly difficult and the people are almost sure to be nomads; below 10,000 feet, in favorably situated valleys, a settled agricultural life becomes possible. Nomad and sedentary Tibetans are fundamentally alike, differing in their means of livelihood and consequently in their habitations and standard of comfort. They speak the same language, wear very similar clothes and practice the same religion. I can see no physical difference between them.

The stature of the Tibetans is moderate. I saw none, either men or women, who seemed very tall. Five feet 8 in. was perhaps the stature of the tallest. The women give a greater impression of height than the men; this, I believe, is due to the very heavy hair ornaments which they wear hanging down the back. The presence of this weight gives them a remarkably erect carriage which combines with their spare figures and big white hats to make them look taller than they really are. The men, whose apparent height is not increased artificially, seem of normal height for the women when they stand beside them; yet one carries off the impression that the men are medium sized and the women very tall. Both sexes have an active walk, though the women are more erect than the men. The face is well proportioned, fairly round, and nearer to our ideas of good looks than the Chinese face. The nose is broad and of medium size; the mouth straight and fairly large; the eyes give the impression of being horizontal, though the Mongol fold is often present. One sees some noses which are slightly aquiline, the tip projecting further down the countenance than the base. A high bridge according to Western standards I have never seen. The forehead is of moderate height, somewhat difficult to observe in the laity on account of the

[11] A few Mongol tribes have become Tibetanized in manners and live in Tibetan country.

headdress. Impressions of head form gained by looking at the lamas are apt to be misleading, because though most of them are Tibetans, there is no guarantee of the nationality and origin of any particular lama.

The skin is brown, very much like the skin of the Mongol. As so often happens, it is difficult to distinguish the effects of sunburn, dirt, smoke and natural pigmentation. The Tibetans often strip to the waist in the sunshine. The sun of that region is hot when it shines, and the pigmentation resulting from its action must be considerable.[12] Dried dung is the principal fuel used in both tents and houses. While reasonable provision is made for its escape, a good deal of the smoke remains inside. This, with the butter which is so constantly in evidence among the Tibetans, may combine to form a sooty and greasy protection for the skin. I have not lived among the Tibetans enough to know whether they are given to extensive washing, but I am much inclined to doubt it. The chill of morning and evening discourages even those who have been brought up to consider soap essential from its too enthusiastic use. Whatever part sunburn and dirt may play, the observed color of the Tibetan skin is not far from light chocolate. I have seen exceptions; a few of the young women, who on closer inspection turned out to be quite the prettiest in their groups, could be noticed at a distance because of the markedly light color of the skin, almost yellow. It may be that these individuals owed both their prettiness and their skin color to some mixture of blood.

The eyes are dark and the hair is usually straight. The very heavy ornaments which hang from it must tend to keep it straight in the case of the women. Occasionally one sees an individual whose hair is distinctly wavy.

In figure the Tibetans are spare almost to thinness.[13] Both men and women are well muscled and strong, but have no fat on them. The breasts of the women are small, and the long pendant breasts so common

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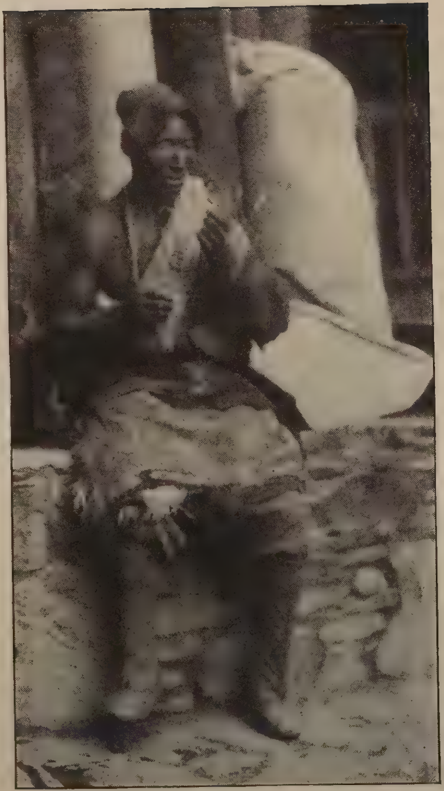
[12] The backs of Chinese farmers in Chihli, who strip to the waist during the summer for work in the fields, become dark brown from sunburn. The chest and abdomen which are less exposed remain many shades lighter. The same man in winter is very likely to show approximately the skin color of a Chinese of sedentary employment, who does not become sunburned from one year's end to the other. Consequently sunburn, or rather sun browning, is a very genuine factor to be considered in the case of "yellow" persons as well as "white" ones.

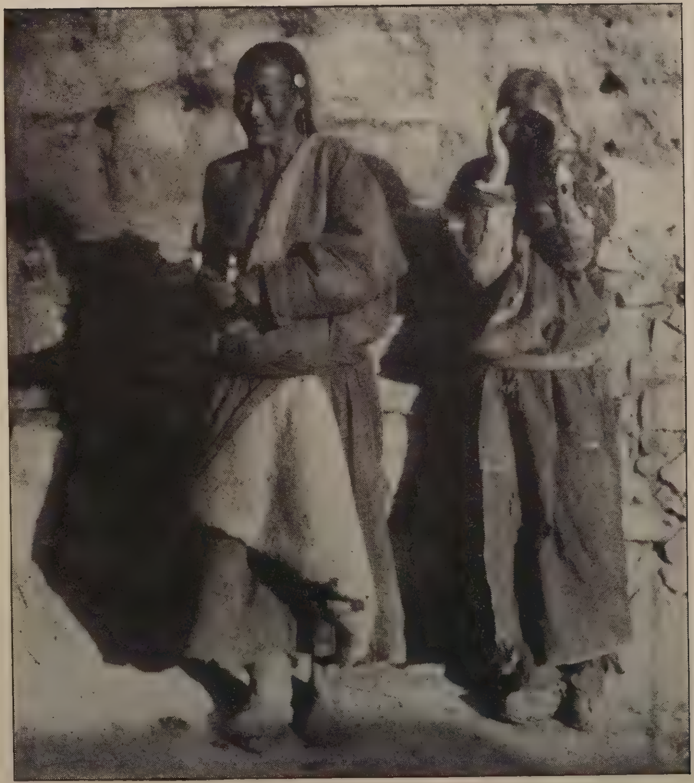
[13] Some of the older lamas carry a little extra weight around the waist, though I noticed this less at Kumbum and Labrang than I did in Mongolia. Even these men can scarcely be accused of being fat; what they show is simply the increase in weight which is general in men over 60. The nationality of the individuals, furthermore, is uncertain; they were probably Tibetans, but may have been Mongols or To Run.

Kansu Moslem. The Official Interpreter at Labrang

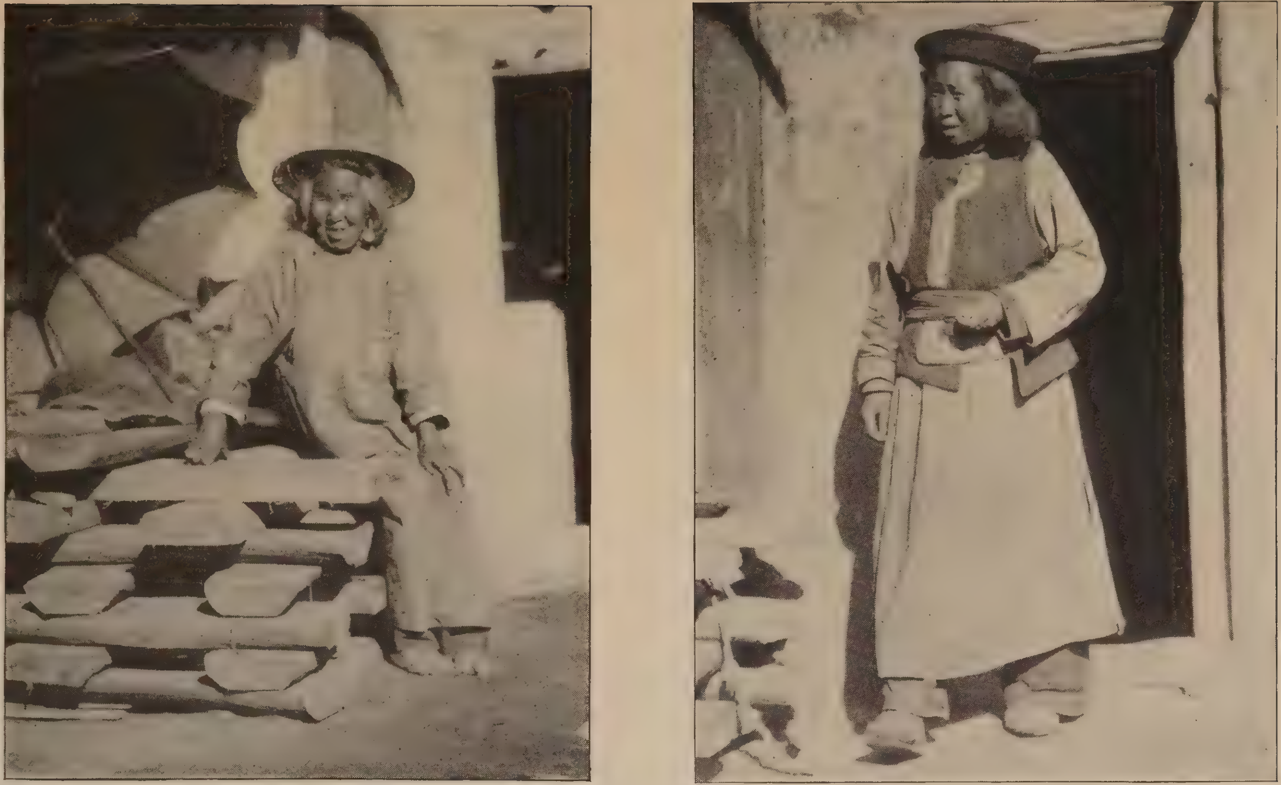
Member of the Bonbo Sect, Tangar, Kansu



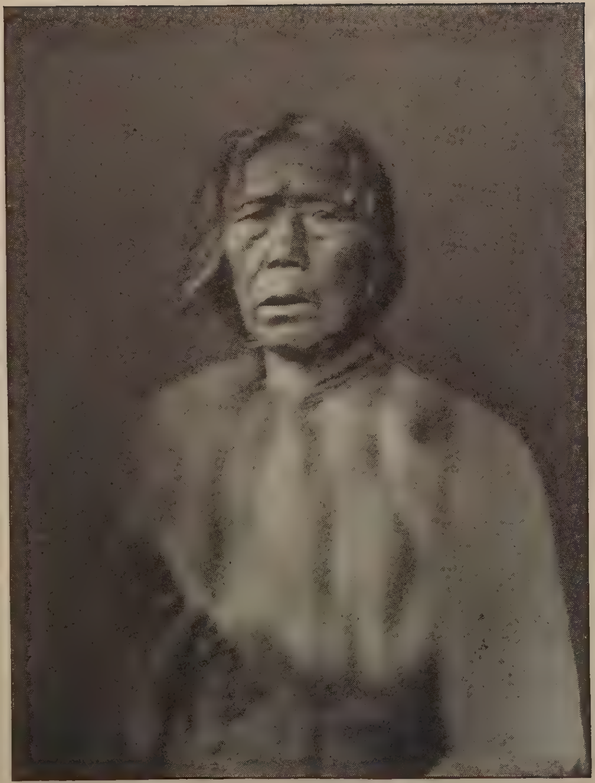
Tibetan Villager, near Hsuin Hua, Kansu



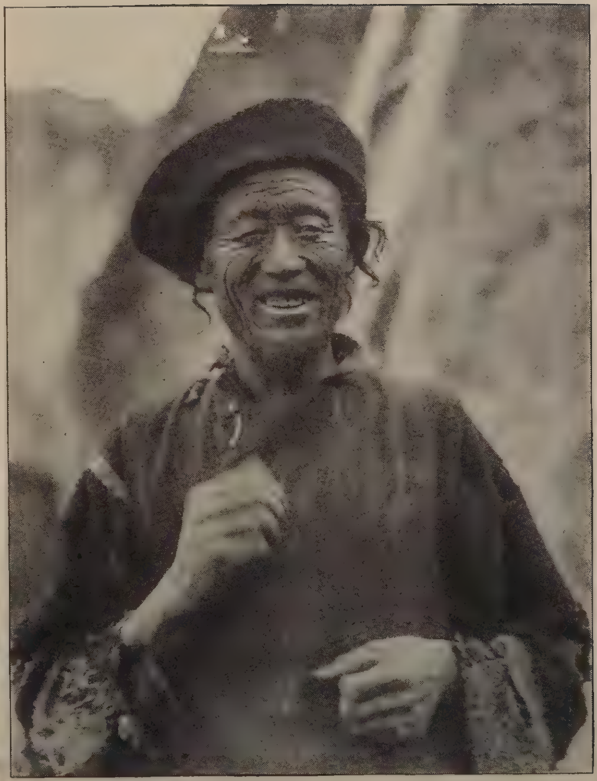
Tibetan Villagers, near Hsuin Hua, Kansu



To Run Women, near Wei Yuan P'u, Kansu



To Run Man, near Wei Yuan P'u. Kansu



To Run Man, near Wei Yuan P'u, Kansu

among African tribes are never seen. I saw no misshapen feet, common among the To Run.

The muscular strength of the Tibetans is very considerable. The women carry tubs of water about a foot in diameter and 2½ feet high, weighting about 100 pounds, up steep hillsides, from brook to camp or house, several times every day. They work hard in field and house and in looking after the animals from early morning until late at night. I have watched a Tibetan woman's bare arm as she stoked her kitchen fire. As each handful of dung or straw was tossed in, one could see a big, hard biceps jump as one sometimes does among American blacksmiths. In spite of their hard work, the women are gay, always smiling, and apparently satisfied with their lot in life. They show no superficial signs of premature age. One sees less evidence of the strength of the men, for at home they are lazy. Still those that I saw showed muscular arms and shoulders, and their long journeys, their reputation as fighters even against the doughty Moslems, and the hardships of their life make it evident that there must be many very strong and hardy individuals among them.

I have little means of judging the intelligence of the Tibetans. They make the impression of being quicker and more responsive than the Mongols. They are devout Buddhists, but they seem to be less completely stupefied by their faith than the Mongols: this may be on the principle that the nearer one comes to the chief center of a religion, the greater the immunity to its doctrines among the laity. The reputation of the Tibetans used to be that of blood thirsty swashbucklers always itching for a fight, with sword in belt and hand on sword. Though they are fond of drinking and are given to quarrels when drunk, I cannot but think their reputation for savagery in exaggerated. At present they have been so thoroughly hammered by the Moslems that they would not dare to receive strangers badly; still if it is possible to judge from every expression and every action, the good reception which they gave us came from a genuinely amiable disposition. It is true that, like many people in an early stage of the development of politeness, they are more inclined to be courteous to a visitor who arrives on horseback, well armed and apparently an equal, than to one who comes on foot with little gear and seems a person of no account. A young missionary of my acquaintance has visited the nomad Tibetans in both guises, and has found that the reception given to his spiritual message when he arrived with a horse and a rifle was far more favorable than when he came on foot like the apostles.

No abnormalities or pathologic conditions were observed among the

Tibetans. Missionaries assured me that syphilis is extremely prevalent and gave the loose sexual habits which are said to prevail among the Tibetans as the cause. It is often difficult to arrive at a just estimate of morality and of the incidence of venereal diseases from the accounts of missionaries, for they are inclined to take an intense view of the subject. It is also commonly true that the field of their mission labors is the first country in which they have observed society as a whole, and as a result their comparisons with conditions elsewhere are not to be relied on. All the Tibetans that I saw looked strong and well.

In their material culture the nomad and the sedentary Tibetans must be considered separately. They have certain points in common, however; the liberal use of barley, milk, mutton and butter in their diet; the general cut of their garments, and the way of doing the hair; the arms used in warfare; and their language and religion.

It is my purpose to present the observations made by this expedition, not to write a full account of the Tibetans. I shall omit many things which are matters of common knowledge because I do not wish to have this paper quoted as direct evidence of things which I know indirectly, from books or from common report. I have not hesitated to include matter which reached me direct from the original observer, however, be he missionary, Chinese or Moslem.

As I have said, the sedentary Tibetans live in all the more sheltered valleys of the region from the Yellow River to Old Taochow. North of the Yellow River, along the road from Sining to Pai Yen Jung and Hsun Hua, I have been assured that the lateral valleys are full of Tibetan villages. The villages along the main road are inhabited by Moslems or by Chinese, and the whole area is one of very marked checkering of nationalities under direct Chinese *hsien* administration. I shall not consider the Tibetan villages north of the Yellow River in this description because I remained on the principal road and did not personally pass through them.

Tibetan houses and villages in no way resemble those of the Chinese. In general a Tibetan house consists of two or more rectangles of buildings facing on courtyards, and placed one behind the other. One or more buildings may be two stories high, usually those towards the rear. Half of the first story will be stable, namely sheds without walls, and part of the main kitchen is often a stable also.

What strikes one first is the enormous amount of wood used in construction, and the comfort and charm of the houses. Nearly all the interior walls and partitions, the galleries upstairs and down, the ceilings and often the floors, are of wood, smooth and well finished. A living room or a kitchen is charming. It is likely to be finely paneled all around, the wood stained dark and polished, and often decorated with fine little paintings on the doors of wall cupboards. Rows of shining copper pots gleam on shelves let into the wall. The dark house mistress, half naked, stokes the big mud cooking range with dung or twigs, and savory smells rise from huge wooden-lidded cauldrons of decorated copper. A long Tibetan gun and sword may hang on pegs in the panels. There is a k'ang near the stove, separated from it by a low railing, but the k'ang takes no such room as in a Chinese house, and one's whole impression is of a Scottish baron's hall.

Live stock is important. The people keep yak, dogs, pigs, chickens, sheep, goats and donkeys. Horses, yak and sheep are brought in through the gate at twilight, the former often to share their master's room.

One village may consist of a dozen or twenty houses, lying on a hillside above some stream. Nearby on the most level soil lie the fields of the villagers. Barley is their principal crop, though sometimes other things also are grown. Men and women work together in reaping, but women predominate. They use a short sickle. Crops were maturing all along our way; reapers worked near Sining late in July, and near Taochow early in September. The grain is stored on high frames of poles where it hangs like a perpendicular thatch to dry. Whole villages are adorned with these scantlings, on house roofs and near threshing floors, which from a distance make them look like a forest of poles. I saw no flails in action, but only light stone rollers with 6 or 8 sides which animals draw over the grain.

As with semi-savages all over the world, the women seem to do all the routine work. The men are idle at home. In one place we visited the whole house seemed living because of our hostess, who was always on the run, smiling; first upstairs for fuel, then downstairs for cooking, to the valley for water and upstairs once more to watch us. She nursed her baby at any spare moment, and called in her friends to see the strange humans. Her husband seemed merely a very idle boarder.

The Tibetan costume is both practical and picturesque, except for the women's head dresses, which are not picturesque only but often magnificent. The hair is done in a great number of long, slender braids which hang down the back to the waist, pieced out with cord if need be. These many pigtails are caught in a frame of red cloth, which swings at the level of the waist behind. It is nearly a foot wide and decorated with shells and discs of silver and brass, which hang down a couple of feet further almost to the ground. At Labrang the frame is square; two marches southeast it has become triangular. Tibetan men usually shave the forehead and wear a short queue in the old Chinese style. The richer folk in towns wear boots with soft leather feet and cloth legs tied below the knee; the country people are generally barefoot in summer. The body dress of both sexes is a long sleeved robe cut like a wrapper, ankle length for the women and knee length for the men. It is held by a girdle of cloth or rope. When they are working or traveling, both sexes pull out one arm or both and tie the sleeves around the waist. All the Tibetan women's garments that I saw were on this pattern; of dirty sheepskin for the nomads; of coarse homespun or sheepskin for the peasants, and of cloth lined with fleece for the fine beauties of Labrang. These last often wear a lighter garment underneath, cut like a Chinese coat, with a dark border; but the country women generally have only one garment, and show a good deal of chest and shoulder when they "unsleeve" for work. The men wear short cotton breeches under their coats, at least in the Hsun Hua-Labrang region, and both sexes are likely to appear in conical sheepskin hats, the brim turned high to show the white fleece inside. No traveling Tibetan man is complete without a straight, heavy sword stuck crosswise in his girdle.

The long wrapper-like garment of the Tibetans is very practical. It is cold when the wind springs up or the sun goes down, and equally hot as one climbs hills in the sun on a still day. When the gown is bound tight and the arms are put through the sleeves, the whole body is fully covered with thick sheepskin and the hands are protected. With one shoulder of the gown dropped off, the right arm is freed for working. At the same time the body is kept warm and clean by the sunshine. If one travels in a fixed direction, the shoulder that is turned toward the sun is exposed. Where both hands are needed, as in the kitchen, the whole garment can be dropped to the waist, leaving the body cool and free; yet if warmth is needed, it can be had in an instant.

The tents of the nomad Tibetans in no way resemble the huts of the Mongols. Our opportunities to visit these dwellings were unfortunately limited. On August 15, 1923, a few miles east of Lake Kokonor, we came to flocks feeding and saw black Tibetan tents scattered in several valleys. The encampment was newly made, for this place had been vacant on our way to the lake three days before.[14] We rode up to one group of three tents where a young man tied up the dog and smilingly received us.

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[14] Golokh Lama informs me that the nomad Tibetans often move their camps simply because the ground has become muddy and filthy through the tramping of cattle. The Tibetans near Lake Kokonor usually spend the summer rainy season in the mountains for the sake of good drainage, and move down to the lake as the soil becomes drier.

The tents we entered were about 25 feet square, made of coarse black homespun sewed together in strips. Inside two rows of poles running from front to back propped up the cloth. Outside were other rows of poles over which the tent ropes passed to be staked to the ground. Horse thieves are said to take advantage of this arrangement by cutting the outside ropes, so the whole tent falls down on the sleepers within. The thieves escape with their booty while the occupants are struggling to find their weapons and get out. The tents we visited had no proper ridge, or point, but were simply great pieces of cloth propped up off the ground, with side walls slightly sloping. A long crack about 18″ wide ran along the top from front to back to let in light and allow the smoke to escape. Cords laced across joined the two halves at the fissure. Immediately underneath this opening stood a long fireplace or stove, built of mud, which may have been two feet broad, and eight feet long with its extensions. Great wooden tubs for water, milk and butter stood before the fireplace; beyond it was a pile of dried dung for fuel. Around the sides of the tent stood a neat double row of bales and sacks and decorated wooden chests containing the worldly goods of the nomads. On the grass floor lay a straight heavy sword and a long old fashioned gun with its prong.

Two weeks later we were crossing a grassy plateau about 11,000 feet high, north of Labrang. There was a great nomad encampment in this region. From one point I counted 27 tents in sight and I was told there were 80 in the neighborhood. These tents were like those that we saw near Lake Kokonor, big, square, black affairs, with many poles outside, covering a great amount of space. Women were carrying big wooden tubs of water up hill on their backs and others were churning butter. We passed many low walls and mud stoves in the lower valleys—the winter quarters of the nomads.

The life[15] of the nomad Tibetans is not luxurious. Those who own from seven to eight thousand sheep are considered wealthy. Others may own a thousand sheep, besides horses and yak, and are comfortable; but I did not learn how large a flock must be to support a family.[16] As a rule the nomads do no farming at all, but there are exceptions; some households near Kueite follow agriculture part of the year and a pastoral life the rest. The nomads eat some yak meat and a great deal of mutton, but eschew the flesh of pig, horse and camel. They are fond of "tsamba," parched barley meal stirred up with hot tea and butter, which is a staple in agricultural regions. They obtain their tea and their barley by trading, so both are luxuries to the poorest nomads. Cheese is made from skimmed milk, ground, dried and eaten, sometimes with a little meal scattered on top as a relish.

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[15] My information on the customs of the nomad Tibetans is drawn from Golokh Lama, who has lived for years at Kumbum. He speaks fluent Tibetan, though by birth a San Chuan Mongol. I have known him in Peking.

[16] A ewe is worth from $1–2. Mex. according to the current price of wool. The price of sheep has gone up in late years as the market for wool has improved.

The social life of the nomads is governed by requirements of pasture. Marriages are made by arrangement and purchase, with a friend or a relative acting as middleman. The degree of feasting and of return visiting depends altogether on wealth and convenience. If both families are rich, the groom's parents may make a large present of sheep to the bride's father, and he in return may give her numbers of animals. On the day of the wedding the groom and his family go on horse back to bring the bride home. On arrival at the groom's tent she k'ow t'ows to the household divinities, to her parents-in-law and to heaven.[17] Then a great feast is made with mutton, and wine brought from the city.

If the parties are poor, much or all of this may be dispensed with. Sometimes the bride's fancy is set elsewhere; then her lover and his friends may attack the groom's party, and a fight ensues and perhaps an elopement. Some women prefer not to marry; marriage means looking after a husband, and if their property is enough they can live the usual life of the nomad, bringing up themselves any children they may have as a result of passing attachments. No stigma attaches. Sexual relations are very loose among the Tibetans, and the further west one goes the looser they are, according to my informant. Monogamy is the nomad custom, but married people can separate at will. The dialogue on this subject was as follows: Q. If they are not satisfied, can they separate? A. Oh, yes. Q. Is there any ceremony or formality about it? A. (Bursts of laughter) not a bit of ceremony.

A feast is commonly made on the birth of a child. The father, or if his intellect does not reach to such heights, a family friend, gives a name to the child. There is only one such name, for no surnames are used, and the child generally keeps it through life; but it may be changed in the course of an illness. If the lama who is called in to foretell the course of the sickness by magic finds that the name has something to do with it, he will promptly furnish a new one. It has been said that in Mongolia the oldest son must become a lama. This is not true in the Kokonor. In some families all, in others none, of the sons become lamas; it seems a matter of the boy's and the parents' inclination.

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[17] It is possible that resemblances between Tibetan and Chinese customs are overstated, as conversation was carried on through a Chinese-Tibetan interpreter, and Golokh would naturally wish his neighbors to appear in a favorable and to him civilized light.

No written testaments are in use, but before a man dies he is likely to express his last wishes. The division of property is usually equal among all the children. Married daughters receive no share, but unmarried ones share equally with sons, and sons' wives share also. If a man dies without expressing his desires as to the distribution of his property, an outsider is called in to make the division. Twenty or thirty per cent goes to his family; the rest, including articles of personal use and adornment, is invested in prayers or goes to the lamas. Prayers are in order before the body is disposed of. At length it is thrown out for the beasts and the vultures, or carried away on a fine yak and allowed to tumble off where it will.

No adequate description of Tibetan metal work can be given without visiting interior centers where the objects they make are abundant. Much is bought from Chinese or Mohammedan traders. Temple architecture and organization have marked characteristics which are dealt with elsewhere.[18] Art and religion are closely interwoven. I had neither knowledge nor time to make observations on the Tibetan language. A learned work in preparation by the Rev. Father Louis Schram, of the Belgian Catholic mission, will deal with the peculiarities of the dialect used in this region.

THE TO RUN

"To Run" is a Chinese expression which means literally "earth men;" it might perhaps be taken to mean aborigines or natives. It is applied by the Chinese to two groups of people; one north of the Sining River, known as To Run to Chinese and foreigners alike,[19] and one on the Yellow River above Hochow, known in Western literature as the San Chuan Mongols.[20] I shall confine myself to the first of these groups, the To Run north of the Sining River, which we ourselves visited. My information comes from two sources: a short personal visit to one of their settlements near Wei Yuan P'u, and the report of Mr. Ching, the botanist of the expedition, who traveled for several weeks among them.

The To Run inhabit a strip of wooded and hilly ground which lies north of the Sining River. The territory in which they are found runs from Liang Chung near Pingfan westward, and then south to the town

[18] See articles in the National Geographic Magazine.

[19] T'u Ssu of Rockhill.

[20] "Trois Vallons" of Huc.

of Wei Yuan P'u, 30 miles northeast of Sining. The district is bordered by Chinese and Tibetans, and the whole population is checkered, though individual villages belong distinctly to one population or another.

The Chinese authorities have long recognized the To Run as a distinct population. Those in the Liang Chung district are administered by a hereditary commissioner or To Sse named Loo, whose full title is Liang Chung Loo To Sse[21]. His functions are to judge minor cases, collect taxes and keep soldiers who can be put at the disposal of the Chinese authorities. At present (1923) the male head of the Loo family is a boy of sixteen and his mother rules for him. She is a daughter of the King of Alashan; for six generations the wives of this family have come from the same court. The taxes paid to the Loo family amount to about 80,000 piculs[22] of grain per year. The military force which they are supposed to maintain is composed of 300 To Run, 300 Chinese, 300 Tibetans and 300 lamas. Apparently this military force does not exist as an organized body; the men are neither armed nor drilled, but stay at home in civil pursuits. I am not even sure that the system amounts to anything more than a vague liability to military service.

The To Run I saw were fairly thickset, but short of stature. Many were shorter than my Chinese boy, who is 5 feet, 4½ inches tall. The features are flat and the lips moderately thick. The mouth is large, the chin narrow; the cheek bones are broad and the expression stupid. The skin is brown, sometimes almost as light as the Chinese skin, and sometimes as dark as the Mongol. The To Run intermarry with their neighbors, so this variation in skin color is not surprising. The eyes are dark and the hair is black. It is generally straight, but, as elsewhere in China, exceptions are far from infrequent.

The To Run do not seem a vigorous people. Though many are passably well built and muscled, lamentable-looking individuals are common among them. Many have goiters. Bunions also are frequently seen, though both men and women go barefoot in summer. Perhaps this deformity is due to the use of ill fitting boots in cold weather. No foot binding is practiced.

[21] The title of To Sse is also used among the San Chuan Mongols and the Choni Tibetans. The institution is an old one, which apparently originated as a Chinese device for administering unassimilated tribes. To such tribes was given a hereditary ruler, chosen either from among their own chiefs or among the officials who had subdued them. He was responsible for the tribe to the Chinese authorities. Gradually as the assimilation progresses, the tendency is to replace the To Sse by the usual Chinese officials and administration.

[22] One picul equals 146 catties or 195 lbs. of wheat in Peking; rather more in Kansu.

The To Run seem stupid. They are timid, fleeing from a camera as they would from a rifle, but that proves nothing. I found one middle aged man who talked intelligible Chinese and had traveled a little. We grew quite friendly. He admitted freely that he did not know how old he was, and remarked that none of them did. Few can read Chinese—far fewer than in a real Chinese village. Altogether they seem to be an inferior people, tolerated by other elements and content with that position. Their low level of comfort and their position without influence bear out this opinion.

Most of the To Run are farmers. A few become artisans or lamas, or stray far afield. There are few shopkeepers among them; the Chinese of neighboring towns supply all their wants. They own yak—many compared to Chinese farmers, few compared to Tibetans—and a few sheep, pigs and chickens. Their principal crop is *ch'ing ko*, a cold weather wheat. Milk, butter, cheese, eggs, and a little meat may come to vary their diet. In the wooded regions through which Mr. Ching traveled, almost all the women wore woodcutters' hatchets thrust through the back of the girdle. These hatchets were of the common narrow bladed Chinese and Tibetan model.

The country near Wei Yuan P'u has many little settlements of To Run. Sometimes a few walled farms lie together near a crossroad. Elsewhere from twenty to forty small habitations form a village surrounded by a high wall with a deep moat around it. The houses inside are distinct with alleys and low walls between them. My impression was, though I could not confirm it, that the high earth walls which surrounded villages were built for protection during civil wars like the Mohammedan rebellion. They were twenty or thirty feet high, roughly finished, without parapet or towers, and pierced by a single small gateway.

The To Run houses which I saw were built of dried mud and timber. They looked like Chinese farms of the poorest description. The rooms were arranged around a very tiny courtyard, and the whole was surrounded by a mud wall six or seven feet high, with a door in it wide enough to let in a cow or a horse. Unlike most Chinese gates into courtyards, these doors were too narrow for pack mules; an evidence of the poverty of the people.

One house was arranged as follows: On the left of the court was a little mud floored porch in front of the living room, the roof supported by wood columns six or eight inches thick. One end of the porch was entirely filled by a neat pile of dung bricks for fuel; the other was closed by a low pile of stones, which restrained the activities of an energetic pig beyond. Inside the living room were a space of dirt floor and an earthen k'ang, the common stove and bedstead of north China, on which stood one or two good painted Chinese chests for clothing and finery. There were jars for oil, water, etc., along the walls of the room. The tools and utensils were such as might have been found in any poor Chinese farmhouse. Across the court lay the kitchen. It contained a good Chinese stove of dried mud, with another k'ang behind it. A few fresh vegetables for that day's dinner lay beside the big semicircular pot.

A young woman and her husband were living here. She fetched her earrings and headdress out of the Chinese chests, which contained other pieces of finery that she would neither sell nor show us. The earrings were kept in a small round wooden box, painted in red and gold. The couple seemed well and strong, both of them, about of an age, and fond of each other.

Mr. Ching[23] saw much poorer houses among the To Run in the mountains east—northeast of the region I visited. The dwellings there were log cabins chinked with mud, arranged around an oblong court; they were roofed over with sticks and dirt, with scarcely five feet head room. The animals were stabled in some rooms, the people in others. Earthen k'angs were used, the smoke escaping through chimneys like little mud volcanoes on the roof. Small square holes served as windows. The food was cooked in thin iron kettles like those which the Chinese use. The general impression that he received was of poverty, smells and squalor.

The dress of the To Run men is likely to consist of a jacket of coarse local homespun,[24] cut in the Chinese style, and Chinese cotton trousers left loose at the bottom. The hair is done in a thin short queue, and covered with a little badly made hat of dark felt, which is simply a primitive cone with the brim turned up.[25] Their feet are usually bare in summer, but Mr. Ching observed shoes of a type worn in China several generations ago, made with stiff soles, two pieces of cloth for the sides, and a decorated tip. The tendency of the men is to dress like Chinese farmers.

The garments of the women are more distinctive. For ordinary work in the house or the village they wear a knee length coat of homespun cut somewhat after the Chinese model, girded in at the waist with a cord or a sash, which is sometimes embroidered. Like the men, they wear black felt hats, loose cotton trousers and go barefoot in summer.

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[23] The botanist of the expedition.

[24] The material is cream colored or black. It is very durable and resists dampness. One constantly sees men and women spinning the thread from which it is woven.

[25] These hats vary widely in quantity and color. They are much worn by Chinese and Moslem travelers in the Sining region.

The hair dressing varies. Mr. Ching informed me that unmarried girls wear braids to the number of 20 or 30 which hang loose all around; married women do their hair in a knot at the back of the head, covered with a little brass cap which is held in place by a harness of red or black cloth. What front and side hair is not caught in the knot hangs loose over the cheeks and shoulders. I saw both arrangements chiefly the latter, but was not able because of the people's timidity to make sure in each case whether the wearer was married. The harness in question consists of a cloth band which goes around the head at the height of the temples, and a further central strip which lies on the top of the head, sewed to the first one at the forehead and back.

On special occasions, the women wear hats and dresses which are quite unique. They appear in long robes trimmed in many colors, and embroidered shoes of the old Chinese model. Their hats, I am told, are various, but I saw only one sort, that looked like a small saddle set on the head pommel down and seat forward. It is of red cloth on a frame, trimmed with bells, fringes and tassels. These hats were worn to a Chinese theatrical performance at Wei Yuan P'u. Some also wore collars about 10 inches in diameter, covered with red cloth and trimmed with large buttons of the shell of a river bivalve called Gö Li Bungze.

The industries of the To Run are simple and few. They make the cloth and the embroidered shoes which they wear. In general their implements follow the Chinese model. Manufactures they buy from traders in the towns of the region.

Mr. Ching saw no opium grown or smoked by the To Run, but they use tobacco. He heard them singing at their work. The men were given to hunting with old matchlock guns of the type that is common in China. I myself saw no musical instruments or weapons.

We had little opportunity to study the social system of the To Run. All I can set down on this subject is the little actually seen, and what was reported to me by Mr. Ching. Apparently their marriage and funeral customs resemble those followed in China. They marry young. The people are too poor for polygamy and I saw nothing to indicate its existence; but isolated cases would doubtless be tolerated, for the neighbors of the To Run have no feelings against it and the idea is familiar. The women seem to have a good deal of influence—at least the woman of the house had the deciding voice whenever we bargained for ornaments. The houses are small. Several held only one couple and their children. In others old poeple were present. Neither Mr. Ching nor I noticed any shrines in their houses. He told me that a vague general belief in *Tien* (Heaven) was the extent of most To Run's religion. Some become lamas.

Though many or all speak Chinese, and some speak Tibetan, the To Run have their own language. It is not written. There are many conflicting statements about it. So many of its words are borrowed from Chinese and Tibetan that short vocabularies help little towards identification. Some have suggested that To Run is very old Mongol, and others that it is based on the Shato Turkish dialect. The present To Run might be descended from immigrants belonging to one or the other of these races. The information now at hand does not justify me in expressing an opinion.

THE CHONI TIBETANS

The Choni Tibetans live in southern Kansu on the Tao River and in the high inaccessible mountains which form the western half of the southern border of the province.

This range, the Min Shan, is the dominating feature of the region. Its summits in places run well over 12,000 feet. The prevailing course of the range itself is from west to east. Its western portion is wild and rugged in the extreme, totally impassable for wheeled vehicles and only to be crossed by pack animals with great effort and difficulty. It contains fertile valleys inhabited by a peculiar Tibetan population. There are stretches of virgin forest with very large trees, untouched because of the impossibility of bringing out lumber. The heart of the mountains is wild and little known; much of it has remained a sealed district.[26] The Tao River and the adjoining villages are quite accessible. East of Longitude 104, the range has diminished in size and ruggedness to such an extent that ordinary commercial routes exist across it into Szechuan. Still further east it has completely lost its impressive character and has become a mere watershed between the Yangstze and the Yellow River. This range continues into Shensi, the neighboring province, where it again rises to considerable altitudes.

The Choni Tibetans are found in the western portion of the range and on its northern slope, south of Old and New Taochow. The district they inhabit extends roughly from Longitude 103 to Longitude 104, south as far as the Szechuan boundary and north to the Tao River. Southwest of the Choni Tibetans live Tepu (Tibetan) tribesmen. Map 1 gives an idea of the topography and the distribution of peoples. I see no reason to believe that those who dwell in this region are anything but a mixture of Chinese and Tibetans. Whatever their origin, they have acquired a distinct dialect and costume; they certainly form a political entity. Their prince told me that they migrated to their present home from central Tibet several centuries ago.[27]

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[26] As far as I know, this portion of the Min Shan range has been crossed only twice by foreigners. The first of these crossings was by General Pereira; the second by Mr. and Mrs. H. C. Emery, who started from Choni on September 11, 1923, and reached Sungpan on September 28, 1923.

The district I have described takes its name from the little town of Choni, on the north bank of the Tao River. Here lives Yang To Sse, a cultivated Chinese gentleman, the tribesmen's hereditary ruler. In Chinese eyes he is a commissioner like those who look after the To Run. To foreigners he is known as the Choni prince. Forty-eight tribes are subject to his authority. He has all the attributes of a subordinate ruler; he levies taxes, rewards and punishes his people, and undertakes minor military operations against the rebellious. He is responsible to the governor of Kansu. They say of him in Chinese that "he has the pig's head, but cannot find the door of the temple"—in other words, he is willing to give bribes to retain his position, but too many officials expect them; he cannot tell to whom the largest bribe should be given.

In physical appearance the Choni Tibetans are intermediate between the Chinese and the Tibetans. Individuals are found who resemble each type. The stature is perhaps a little shorter than that of the Tibetans, and the skin distinctly lighter in color. The straight nose and the somewhat triangular face sometimes observed among the Tibetans are a trifle less pronounced. I noticed no special deformities among them. The women's feet are not bound. I spent two days in a village[28] 20 miles south of Choni, and hunted in the mountains. My guides were mentally quicker than Mongols, and seemed on a level with better-class Chinese farmers in power of understanding and reasoning.

The physical powers of the villagers are considerable. At an altitude of 10,000 ft., they climb very steep long slopes with no signs of distress. They are sure-footed, good hunters and quick of eye; but these things are true of native woodsmen in any part of the world. An appearance of physical excellence comes from the fact that such people know the

[27] My own travels took me only thirty miles south of the Tao. Consequently the notes which I give below are applicable to the Choni Tibetans whom one sees at the town of Choni and within a short distance south of it. The population shows less Chinese influence as one advances into the mountains.

[28] This village, called Archüen, is well known to foreigners. Wallace has described it in "The Big Game of Western China."

country thoroughly, and are in excellent training for the particular kind of physical effort which is required. Usually a healthy white man will equal or surpass them if he has anything like equal opportunities for adjusting his mind and his muscles to the local situation.

The general organization of life among the Choni tribes is very similar to that observed among the sedentary Tibetans, and described under that head. The buildings of Choni are most of them Tibetan; the yamen or palace is purely Chinese; Lamaism is the prevailing religion; Moslems are practically absent. Palings of sticks surround some of the villages. Muddy lanes wind between the houses, which are like those of the farming Tibetans. One finds the same 2-story structure around a very narrow court, with finely paneled kitchen-living room below. The copper utensils in the house of Chun, the richest man of Archuen, were truly magnificent. There were five semicircular cooking pots laid into the long mud stove; each pot may have been twenty to twenty-four inches in diameter and was more than one-half inch thick. A border several inches wide around the top was beautifully made, and decorated with deep cut patterns, which showed either casting or carving of the most elaborate description. The teapots had the same character; they were extraordinarily heavy for their size and decorated with a richness and fine detail not seen in European work since the Renaissance. Chun told me that they were heirlooms in his family and could not be replaced; nor would he sell them.

Many valleys are cultivated, but idle ground is abundant. Thick forest begins at the edge of the fields and runs up to the summits. There are also hillsides which produce only grass, and cliffs which jut into the sky. In my observation the north slopes and bottoms are wooded. Near Archuen the chief crops are winter wheat, potatoes and barley. Besides this, the natives eat butter, and the meat killed in hunting. They keep yak, horses, donkeys, sheep, goats and captive pheasants, which are raised from wild eggs for the plumage.[29] They hunt with long muzzle loading match locks, supported when firing by a fork which rests on the ground. The stock resembles that seen on the European arquebus of about 1640, or on the cross bow of the Middle Ages; it is not of the execrably bad Chinese model.

The people in Choni and near it wear chiefly white homespun. In town the men dress like Chinese; in the country more like Tibetans. The women of Choni wear a long smock of white homespun, buttoning on the right side, held in with a sash and split at the sides from the lower edge to the hip. Underneath it are brilliant red trousers and little boots of cloth and leather that come half way up to the knee. Their hair is dressed in three long braids, which hang down the back, the braiding of the middle one beginning a little below the collar. Above this the middle strand of the hair is loose and fluffy, held in by a wrapping of cord near the head and another just over the braid.

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[29] The feathers are an important article of export. The birds are kept in individual pens on the tops of the houses. Old Taochow is a great center for the commerce in feathers.

The village people are dressed in similar fashion, but less richly and well. I did not see among women that very characteristic Tibetan custom of dropping the gown from the right shoulder. I did, however, see it among traveling men that we met with and among youngsters, who were as innocent of underwear as are the Tibetans. The Archuen villagers I stayed with all wore undergarments just as the Chinese do. Their clothing was of cloth and not sheepskin. It was hard for me to tell whether the people we met when out hunting, who wore Tibetan costume were real Tibetans passing through, or men from neighboring villages in cheaper clothes than those of my companions.

The language of the Choni tribe is said to be a mixed local dialect, useless elsewhere. I am told by resident missionaries that it is a mixture of Chinese and Tibetan.

THE PEOPLE OF MA CHUANG

The village of Ma Chuang lies in Latitude 39° 25′ N, and Longitude 99° 12′ E, on the road to Turkestan which forms the northwestern extension of Kansu, between the cities of Kanchow and Suchow. It is inhabited by people who speak a language different from that of their neighbors.

My information on this village and its inhabitants comes from the Rev. Father Louis Schram of the Belgian Catholic Mission at Ningsia. Some 15 years ago, on the strength of reports made by the Russian explorer Kozlov, a M. Maloff of the University of Kazan in Russia came to Ma Chuang to study the inhabitants. He knew the Turkish language and concluded that the dialect in question was old Turkish. Father Schram's own reading indicates that the inhabitants of this village are descended from an old Ouigur tribe who were settled here by the T'ang dynasty, after they had been defeated in one of the many wars which were fought for leadership in Mongolia.

Rodney Gilbert, Esq., of Peking, has given the writer a most illuminating suggestion which bears on the languages spoken by the To Run, the San Chuan Mongols and the people of Ma Chuang. He points out that the old Mongol language was a *lingua franca* developed in the enormous armies of Ghengis Khan, which were formed of men from all the tribes of Central Asia. Old Mongol, then, would include much old Turkish. A people split off from the armies of Ghengis or from those of his immediate successors, and subsequently living in linguistic isolation, might well retain a dialect, Turkish or other, which in times past was one of the ingredients of modern Mongol.

THE MANZE

Southeast of Liangchowfu, just inside the great wall and in Latitude 37° 20′ N and Longitude 103° 0′ E, live a people who are locally known as the Manze. The Rev. Father Depeyt, a Belgian missionary with whom I spent one day in a very poor inn in the desert, first told me of them; the information which he gave was subsequently confirmed by the Rev. Father Louis Schram.

The Manze are described as a people of shrewd swindlers and fortune tellers, who impose on the credulity of the neighboring Chinese. They live in their own villages and speak their own language, as well as Chinese. The feet of the women are not bound. Father Schram maintains that the Manze language is a secret jargon constructed of Chinese words. No further details are available about these people.

BIBLIOGRAPHY

W. W. Rockhill. The Land of the Lamas. 8°, Century Co., 1891.

Huc. Travels in Tartary, Thibet and China. Transl., Nat. Illus. Libr., London, 1850–52.

G. F. Andrew. The Crescent in North West China. 8°, China Inland Mission, 1921.

LITERATURE

UEBER FORMBESTIMMENDE URSACHEN AM SKELETT UND DIE ERBLICHKEIT DER KNOCHENFORM. By Weidenreich (F.)—*Arch. f. Entwicklungsmech. d. Organismen*, 1922, LI, 436–481.

Chiefly from a detailed analysis of form and structure of calcaneus and tibia in primates, newborn and adult man, and some human beings with pes equinus and varus, the following main conclusions were reached: The typical human skeletal forms, found in adults, which phylogenetically have to be regarded as new acquisitions, are not hereditarily fixed but develop during the ontogeny of each individual exclusively as the result of normal static and mechanical conditions characteristic of man. The development of the typical arrangement of the inner structure of the bones, particularly the spongiosa, is explained in an analogous way. In a woman with *pes equinus*, who never had used her feet at all, the calcaneus had retained essentially the form found in the newborn, at which time it is not yet characteristically human.

A. H. SCHULTZ

THE DETERMINATION OF THE PERCENTAGE OF THE ORGANIC CONTENT OF COMPACT BONE. By Radasch (H. E.)—*Anat. Rec.*, 1921, XXI, No. 2, 153–187.

Five methods for the determination of organic content of bone are here given. Of these the ordinary method of cleaning (maceration) should be avoided, as results cannot be consistent owing to the irregularity with which bones of the same individual decrease. All of the other four methods are constant and reliable, and every one may be considered as a standard. If the moisture and soluble material be considered organic content, then our text-books are low to the extent of 6 to 7 per cent. If, on the other hand, they are excluded and the percentage still be determined in the green weight, then the text-book percentage is 2 to 3 per cent too high. Even in oven-dried bones the percentage of organic contents in reference to the dried weight is still high—37.15 (20–60 years) and 36.22 (61–90 years). The writer is inclined to consider the green weight the proper one for starting. After the bone has been freed of all periosteum, cancellous tissue and surface oil, its weight should be the one used and the ultimate results would come under the determinations *f/a* in which the average organic content is 40.75 per cent (20–60 years) and 42.32 per cent (61–90 years).

ZUR ANATOMIE UND MECHANIK DER SYMPHYSIS STERNALIS. By Gelderen (C. van)—*Zeitschr. f. Konstitutionsl.*, 1924, X, 367–380.

Investigations on the sterna obtained from autopsies on 132 Dutch people, ranging in age from birth to 90 years, led to the following main results: The average length of the adult sternum (without xyphoid process) in men amounts to 16 cm., in women to 14 cm. The percentage length of manubrium to corpus sterni averages in men 52, in women 56.

Synostosis of the symphysis between manubrium and corpus occurs in women in 20 per cent, in men in 7 per cent of the individuals over 30 years of age. The angle formed by the sagittal axis of the manubrium and of the corpus is on an average in children 7°, whereas in adults 10° and in persons over 70 years of age even 14°. The movability between these two parts of the sternum is greater in women than in men (this was found by measuring the minimum and maximum flexion of the manubrium against the corpus on the fresh sterna). The variability in the proportions of the sternum is very marked, e. g., the manubrium: corpus-length index fluctuates in adult men between 38 and 80.

A. H. Schultz

Tre casi di articolazione coraco-clavicolare osservati radiograficamente sul vivente. By Frassetto (Fabio)—Repr. fr. "*La Chirurgia di organi di movimento*," 1921, V, fasc. 1; 8 pp.

Author reports three new cases of coraco-clavicular articulation in two colored, and one white woman radiographed in the Johns Hopkins Hospital, Baltimore. In the two negroes the anomaly was bilateral, in the white woman it was restricted to the right side. He discusses the role of the caracoid ligaments and the apparent relative frequency of the anomaly in the tuberculous.

RACES

Inter-Racial Problems and White Colonization in the Tropics. By Gregory (J. W.)—*Rep., B. A. A. S.*, Toronto, 1924, 124–147.

The author, after an interesting discussion, concludes that "the white man is not physiologically disqualified from manual labor in the tropics and may colonize any part of Australia, thus simplifying racial problems, as it provides an additional outlet and spacious home for the European race. . . The world has reached its present position by the help of each of its three great races and it still needs the special qualities of each of them. The contemplative Asiatic founded all the chief religions, the ethical basis of civilization. The artistic Negro probably gave the world the gift of iron, the material basis of civilization. The administrative genius of the European race has organized the brain power of the world to its most original and constructive efforts. The affectionate, emotional Negro, the docile intelligent Asiatic and the inventive, enterprising European do not, however, work at their best when associated in mass. That association is attended with serious difficulties; for race amalgamation, which is the natural sequel, is abhorrent to many nations, and the intermarriage of widely different breeds, according to many authorities, produces inferior offspring. The policy of co-residence with racial integrity has failed to secure harmonious progress in North America and South Africa. The development of the best qualities of the three races requires their separate existence as a whole, with opportunities for individual association and co-operation.

"In view of the inter-racial difficulties that have developed wherever the races are intermingled, Australia will throw away a unique opportunity if it fails to make a patient effort to secure the whole continent as the home of the white race."

It is regrettable that the interesting discussions that were specially arranged for in connection with this paper are not recorded.

MANUEL DE L'ANTIQUITÉ SLAVE: I. L'HISTOIRE. By Niederle (Lubor)—Paris, 1923, 8°, 246 pp. with map (Édouard Champion).

This is the first volume in French of Lubor Niederle's monumental work on the archeologic and ethnic history of the Slav peoples, the original of which, in Czech, will form no less than twelve volumes. The present volume, supplemented by a valuable map, deals with the ethnic history of the Slavs. It is not a book to be abstracted or even reviewed, for from cover to cover it is a mine of information gathered by the foremost student of the subject. All that needs to be said is that it will be very useful and in fact indispensable to every library of importance.

RASSENKUNDE DES DEUTSCHEN VOLKES. By Günther (Hans F. R.)—6th issue, München (J. F. Lehmann), 1924, 8°, 504 pp., 566 text figs.

A handsome volume which, since 1922, has reached a sixth issue. It is rich in portraits and other illustrations, and may be characterised as a popular work though much above the general level. Its disadvantages are the German script and no small amount of nationalistic and especially "Nordic" coloration. The contents follow:

Anthropology and Generalities. The conception of "Race;" Brief Historical Notes; The Five European Races; Anthropometry; The Physical Characteristics of the Nordic, Western, Dinaric, Eastern and Eastern-Baltic Races; Growth, Aging Diseases; The Mental Characteristics of the Five European Races; The Distribution of Races in the German-speaking Territory; Environment, Heredity; Mixed Blood and Mixtures; Prehistoric Racial Conditions in Europe; The Nordic Race in Prehistory and History; Race and Language; The Present Position of the German People from the Racial Point of View; Lessons of the Foregoing; to which is added an Appendix on the Racial Conditions of the Jews.

From the point of view of a German the book is doubtless very acceptable. For an outsider it is merely another item, though above the average, in the mistaken "Nordic" glorification and the spreading of a fallacy for which Anthropology must not be held responsible.

DIE BASTARDE DES NÖRDLICHEN NORWEGENS: EINE AFFINITÄTSUNTERSUCHUNG. By Bryn (Halfdan)—*Mag. Naturvidenskab.*, Kristiania, June, 1922, 137–161.

Considering the racial composition of the people of the northern parts of Norway, the author believes that he can distinguish three different types. The first is a large block of mesocephalic, leptoprosopic, tall people, leptorrhin, blue-eyed and light-haired; the second, a small block of short, euryprosopic, mesorrhin, black-haired and dark-eyed brachycephalic strain; and the third, still smaller in number, of hyperbrachycephalic, strongly euryrosopic and even shorter people than the preceding, chamärrhin, with brown hair and lighter brown eyes, as well as a *plica marginalis*. In examining the Lapps one finds the same three types among them, but in very different proportions (the first and third each about 30 per cent; the second the remainder). In places the above types are still almost pure, in others there is much admixture.

THE ETHNOLOGY OF MALTA AND GOZO. By Buxton (L. H. Dudley)—*J. Anthrop. Inst.*, 1922, LII, July-Dec., 164–211.

"This report refers to a part of the material collected in December, 1920 and January 1921, by an anthropological expedition from Oxford." The present paper deals with the Geography, History, Demography and Physical Anthropology of the two islands. The skeletal material ranges from Neolithic to recent. The conclusions are as follows: "The race in Malta which is associated with the period of great megalithic buildings—a cultural stage we have termed Malta Local Neolithic—appears to be closely akin to the Mediterranean race. This is our "Malta first race." At a later date, possibly towards the end of the Bronze Age, but more probably during the Early Iron Age, Malta was peopled by a race with different characteristics, our Malta second race. These people are of Armenoid type, but probably have an admixture of Mediterranean blood. Their origin appears to be Eastern Mediterranean. They may have come to Malta either directly or by way of Carthage. They may have destroyed the previous inhabitants or they may merely have pursued methods of peaceful penetration. This race has firmly established itself in Malta and all subsequent introduction of foreign blood has failed to raise the variation. During the course of years certain changes have taken place; there are also certain local variations, but the differences between Malta and Gozo are not greater than the differences between the general population of Malta and at least one and possibly more, of the more isolated villages."

RICOGNIZIONE DELLE OSSA DI DANTE FATTA NEI GIORNI 28–31 OTTOBRE, 1921. By Frassetto (F.) with S. Muratori, G. Sergi and Corrado Ricci—*C. R. R. Ac. Naz. Linc.*, 1923, Ser. V, XVII. Fasc. 1, 4°, 30 pp., 12 pl.

On October 29, 1921 a small committee of scientific men and others reopened Dante's tomb at Ravenna to see if the skeletal remains of the poet were properly preserved and to utilize the occasion for additional observations on the remains. Earlier observations were made in 1865. The bones were found in fair condition, were photographed (the photos are reproduced in the report), and measured. The data obtained show that Dante was of medium stature (near 165 cm.). The head was large (capacity 1700 c.c., calculated brain weight about 1480 gr.), mesocephalic (C. I. of skull 75.6), and in every respect well developed. For many interesting details it will be necessary to consult the original.

ANTHROPOLOGY OF NORTHERN CHINA. By Shirokogoroff (S. M.)—*Roy. Asiatic Soc.* (North China Branch), Shanghai, 1923, Extra Vol. II, large 8°, 127 pp., with map.

"From an anthropological point of view the Chinese are a complex of different anthropological types, which may be distinguished in an amalgamated state among the Chinese. These types are more or less distinguishable among other ethnical groups. The present distribution of these types in the territory furnishes some data for establishing the ethnical movements in the past. The Chinese lived within the limits of West-Central China, whence they moved eastward, northward and southward. The Chinese movement eastward resulted in the amalgamation of the Chinese with the native ethnical groups of this region, *i. e.* Tungus and Palaeoasiatic groups. The influence of the Chinese type may be observed among the present population of Manchuria and partly Korea. The interaction of the Chinese and other ethnical groups resulted in the continuous amalgamation of the fundamental Tungus and Palaeoasiatic types. The interaction of the Chinese and Mongols resulted in the Mongol movement eastward, northward and westward. Thus the Chinese movement had exclusively important influence on the history of Europe—the Huns provoked the Great Migration in Europe and removed the German and other ethnical groups who lived at that time in Europe. Also indirectly this movement influenced the failure of the Roman Empire. The Mongol pressure on the east caused probably the Tungus migrations and the formation of the new states. The decline of the Mongol Empire resulted in the formation of two great powers—Russia on the west and Manchu on the east. This movement interrupted the peaceful trade between Ancient China and the Mediterranean cultural circle. The Chinese movement eastward and northward was stopped only by the Russian migration. In Manchuria the Chinese movement always grows and forms now the majority of population."

THE CHARACTER OF RACES. By Huntington (Ellsworth)—New York, 1924, xi+393 pp. 19 figs in text. (Charles Scribner's Sons; $5).

"This is a study of the ways in which racial character is moulded and modified by environment, a presentation of the power of environment to affect the development of man."

The book opens with a general discussion of the qualities of persistence and variability in racial characteristics. The author then narrates the probable origin of man and his distribution over the face of the globe as the result of certain phases like glacial periods, and speculates upon the probable setting of racial characters as a result of the diverse environments into which various sections of the human race were thrown. He proceeds then to discuss several examples of man, such as the Chinese, the Hebrews, the American Indians, etc., and to show how their characteristics seem to have been moulded by environment—not only the environment of nature but that of contiguous races—and by such human forces as war. He further discusses the effects of certain typical forms of life upon men, such as the life of the desert, the life of the highlands, of the islands, of those lands subjected to winters of great duration, etc.

The book is divided into twenty-three somewhat heterogeneous sections, which are as follows: Racial character and natural selection; First steps in human character; The earliest great migrations; Glaciation and the supremacy of Europe; The suppression of America; The classification of races; The anomalies of aboriginal America; The Asiatics who dwell in tents; Jews, Armenians and Turks; Cycles of Chinese history; North *vs.* South in China; The scourge of famine; The selection of the Chinese; The three great races of Europe; The character of modern Europe; The contrast between Greeks and Irish; The dispersal of the Northmen; Warlike Normans and peaceful Icelanders; The persistence of a selected inheritance; The direct effect of environment on character; The selection of modern Americans; The racial tendencies of civilization; and A racial test of cities, democracy and feminism.

The author does not deal with the biology of human modifications. He believes that, "As to how or why such mutations or deviations occur we have as yet no definite kowledge. . .Hence this book is an attempt to investigate the inter-relations between migration, racial mixture, and natural selection. The purpose is to discover, if possible, how these three processes cooperate with mutations or deviations in giving rise to the character of races or of racial stocks." Nevertheless he attempts to elucidate the causes and process of man's evolution. Recognizing the now generalized view that man could only have originated outside of the forests, he brings this rather more ingeniously than convincingly into connection with the presumed disappearance of forests through dessication in Central Asia, which is far and unknown enough still to retain its fascination. The American man he derives from Asia before, at least, the last glacial invasion, which would correspond to the older parts of the Neanderthal period in Europe. In dealing with the "Anomalies of Aboriginal America" he attempts to use Dixon; the "anomalies" dealt with, however, are those of a cultural nature.

A critical reviewer of the book would find ample opportunity for both agreement and disagreement in every chapter. Its weakness lies in anthropology, its strength in author's discussions.

THE QUESTION OF RACIAL PURITY. By Boas (Franz)—*The Amer. Mercury*, 1924, 163–169.

An able even if not thoroughly convincing paper, dealing with racial equality rather than purity. The author's conclusions are as follows: "Local types of man are domesticated forms which are fairly uniform only in small inbred groups. Large areas inhabited by a great many families consist of many familiy lines of different hereditary qualities. The ability of the distinctive types to meet environmental and social requirements is not measured by their anatomical differences, because types exhibiting considerable difference in anatomical structure become functionally adjusted to similar environmental conditions. Our knowledge of the reactions of men living in diverse cultural forms and the study of the cultural forms themselves lead us to infer that hereditary characteristics are irrelevant as compared to social conditions, and that anatomical form does not determine the cultural history of a people"—statements which are particularly timely in connection with the recent illusions about the "Nordics." But Dr. Boas goes farther than this, even to the Negro. "It is particularly worth remarking that the current unfavorable opinion of the Negro is based largely on complete ignorance of African native conditions and of Negro achievements in the industries and arts and in political organization, and that likewise the glorification of our own race is founded exclusively on a consideration of the cultural opportunities given to the few and on complete neglect of the cultural primitiveness of the great mass of individuals, which finds expression intellectually in the uncritical acceptance of traditional attitudes and emotionally in the ease with which they succumb to the power of fashionable passions. We may say with certainty that the local types of a single race like the European are each so variable that fixed hereditary differences in mental characteristics between the type as a whole are most unlikely. We may say, furthermore, that cultural anthropology makes the existence of fundamental racial differences very improbable." Regrettably the author does not define his meaning of the term "fundamental."

ARE THE VARIOUS RACES OF MAN POTENTIALLY EQUAL? By Hall (H. N.): and ARE THE RACES POTENTIALLY EQUAL? By Goldenweiser (Alexander)—*Proc. Am. Philos. Soc.*, 1924, LXIII, No. 2, 208–221.

An interesting discussion of a great and delicate problem, or rather a field of problems. Both speakers approach it from the cultural point of view only, and restrict their consideration to the African and American Negro. Dr. Hall's position will be seen from the first three paragraphs of his paper:

"In the absence of accurate special means for the appraisal of intelligence and character, it is permissible to apply the test of history to the consideration of the achievements of a race and from an examination of its past performances to predict its probable future.

"In order to answer the question which has been proposed, we may restrict our attention to one group of people relatively homogeneous in physical constitution and appearanc, that is to one race. If we find that the culture of such a group is likewise homogeneous and if study of this culture reveals a certain type of spiritual weakness which has kept the race backward throughout its history, we are of course justified in saying that this race is not the equal of the race or races whose mental vigor has been responsible for the building up of what we know as civilization. If this kind of inferiority is incurable and so, we may infer, congenital, we must of course also deny that the race in question is potentially as well as actually the equal of the civilized peoples.

"I believe that a study of the culture of the negro and of the history of his contacts with white civilization justifies this conclusion with regard to him."

Dr. Goldenweiser in his paper tends to defend the opposite view, yet without making any clear statement of his opinion. Unfortunately the paper impresses one as more of a special pleading than a serious critical presentation. The author should be more definite.

LES ANCIENNES RACES EUROPÉENNES ET LE SUBSTRATUM DES NATIONS MODERNES (A L'AGE NÉOLITHIQUE). By Lecca (O G.)—*Rev. Univ. Bruxelles*, Dec.–Jan., 1923–'24, No. 2.

The author attempts to show the neolithic substratum of the existing European peoples. The article contains a good deal of interest even if, due to the complexity of the subject, it is not everywhere of equal value. The time for a more definite treatment of this subject will not be ripe until there is much clearer light on the ancestry and type or types of the Kelts, Gauls, Slavs, Alpines and the so-called Dinaric people.

Racial Realities in Europe. By Stoddard (Lothrop)—8°, N. Y., 1924, (Ch. Scribner's Sons, $3.00); 252 pp., 3 maps.

The latest of the Scribners' series of free-lance books, dealing glibly with "races," nationalities, mental characteristics, heredity and other matters sometimes regarded as rather difficult problems but which evidently lose all uncertainties under a righteous, even though businesslike, patriotic indignation, spurred on perhaps by the spirit which hanged Ann Hutchinson because she was a Quaker.

The trouble with the country now and with Europe as well, is no longer religion, nor even the classes—it is "races." If only the world were or could be built all of the "Nordics," everything would be satisfactory; but there are others, inferior, degraded, particularly the broadheads, a breed of the otherwise sterile central Asiatic mountains and deserts. That they and the "Mediterraneans" are inferior is seen plainly enough from their histories. Even if in some way they at times reached very high they never could sustain themselves at the height—though this is not the author's argument. He does better.

For him "Great Britain is predominantly of one race, which accounts for the consistency of her policies. France is composed of all three of the European races, Nordic, Mediterranean and Alpines. This often accounts for the nature of French policy and for its uncertainty. The change in Germany's character and policy is due to change in racial proportions"—too many broad heads.

"Would you understand what is happening in the world, why nations act as they do, what their relations are to America and what our policy should be towards them?"—why, read Stoddard. "Unless you thus understand, you cannot act so successfully and efficiently in your own every-day activities, whether you be a banker, manufacturer, politician, farmer, professional man or wage-earner."

The "races" are shown to have peculiar physical characteristics, for which the reader would vainly seek in heavy Anthropology. Thus (p. 7) the pure-blooded Alpine is. . . dark-complexioned, but differs from both the other races in being round-skulled. Of medium height, the Alpine is of distinctly heavy build, bones and muscles being alike stockier and less gracefully proportioned than either the tall Nordic or the slight Mediterranean." And "these races differ not merely in outward appearance, but also in mind and in temperament," all of which is shown clearly later on.

Most interesting is the newly-found origin of these races: The Mediterranean race is—strangely—a distinctly southern type (p. 10), probably originating in South Central Asia—which must be somewhere around the Pamirs and Thibet, if the reviewer is not mistaken. The Alpine race (p. 12) "originated on the high plateaus of West Central Asia"—

identity uncertain—and has never lost the Cain's sign "the imprint of its ancestral home." One of the marked characteristics of this race according to Mr. Stoddard is that "when they do migrate they move in groups." The Nordic (p. 16) "seems to have originated in Northeastern Europe," which if we look at the map is northern Russia.

The Alpines have many solid virtues, but rather poor mentality. That is why Germany has gone down. There is fortunately no Alpine blood in the British Isles, the testimony of the round barrows and of the twenty odd per cent of present brachycephals in the isles notwithstanding. And the total absence of Alpine blood in the British Isles is undoubtedly one of the chief reasons for the high qualities of its inhabitants.

The "Nordics" are naturally superior in all that is worth while. Even in politics—"Political ability is one of the Nordics' chief gifts" (p. 17); which suggests that the U. S. Irishmen may have learned by imitation. Also "Where the Nordic established himself among other races he is instinctively aristocratic...he prides himself on his race and seeks to guard the purity of his blood" etc., etc.

The book is full of gems of this nature and even better. It is worth buying for this reason only. Just one or two others: The Nordic (p. 20) "is essentially a high-standard man. He requires healthful living conditions (see medical histories) and (strangely) pines when deprived of good food, fresh air and exercise. Our modern scientific age is mainly a product of Nordic genius. Deprived of that genius it would rapidly decline"—*e. g.* the Alpinized French, Germans, Russians and others. Ireland, by the way, in Mr. Stoddard's analysis, is not Keltic; it is with Wales (p. 22) predominantly (Wales three-fifths, Ireland over two-thirds) Mediterranean. Germany is nearly two-thirds Alpine, with only the remainder predominantly Nordic—Dr. Günther *et al.* please take notice. The Swiss have two-thirds, the Austrians over two-thirds of the same misfortune; but of course the aristocracy tends everywhere to be Nordic.

Naturally all this has its moral which is, in brief, America for the Nordics; for "if the United States should cease to be a mainly Nordic land, *our* America would pass away" (p. 239), and with it doubtless a chance for the publication of such precious books as this. All of which is presented broadly and pressingly.

And with this the fountain begins to flow warmer and warmer until it unconsciously ends among well-remembered axioms the fitness of which could not be surpassed by the reviewer: "Hitherto Man has not only known comparatively little but has tended to misinterpret the little that he knew. On slender fact-bases he has reared elaborate theories, fine-spun from his logic and imagination, and he has then crystallized these theories into beliefs so dogmatic and intolerant that they have blinded his vision and closed his mind" (p. 232)..."Nothing is more dangerous than illusions" (p. 246)...The book has a glaring red wrapper...

Regrettably and unaccountably, according to the latest information, "there has been a singular cessation of interest" in books of this nature.

A. Hrdlička

WHO ARE THE NORTHERN CHINESE? By Shirokogoroff (S. M.)—*J. N. China Branch Roy. Asiatic Soc.*, 1924, LV, repr. 8°, 13 pp.

"The Chinese of Northern China of the study are composed of three groups—those of Chihli, those of Shantung and those of the three provinces of Manchuria. These groups can be considered as forming two main groups—that of China Proper and that of Manchuria. The average stature of these two main groups differs about 3 cm.—163 and 165; the average cephalic index for these groups gives a difference of about 5 units; other characteristics are also in positive correlation with the stature and cephalic index. The nasal index and frontal index that correlate anatomically neither stature nor cephalic index, show also very striking differences of these two main groups, so that comparatively the Chinese of China Proper can be characterized as a people taller, with more ellongated head, open forehead and broad nose; and the Chinese of Manchuria are shorter, with round heads, small foreheads and narrower nose. The cause of these differences is intrusion of some foreign blood into that of Chinese of Manchuria—immigrants from China. These foreigners are evidently natives of Manchuria, that is the Manchus and, maybe, Koreans. The anthropological data concerning these groups confirm *absolutely* this supposition. In fact, the Manchus are shorter than the Chinese of China Proper, they have rounder head, narrower nose and small forehead. Thus the differences between two main groups of the Chinese is due to foreign influence. But the problem is not so simple. The Chinese of China Proper are not at all homogeneous—among them can be distinguished at least four different types." These types are characterized in the main as follows:

Type	Ceph. Ind.	Stature	Nas. Ind.	Front. Ind.
A	75	175	105	80
B	90	160	110	82
C	76	159	75	60
D	85	169	75	62

WHO ARE THE MELANESIANS? By Hocart (A. M.)—*J. Anthrop. Inst.*, 1923, LIII, July–Dec., 472.

There is a confusion in the use of the term "Melanesian." "It is used of a family of languages, of the inhabitants of a group of islands known as Melanesia, and of a certain type of men found chiefly in those islands. . . This double use of the word has caused many to identify the orignal speakers of Melanesian with the physical type, which is usually known as Melanesian. This may not be stated in so many words, but it seems to be tacitly assumed. Now it is highly improbable, one might say impossible, that the original speakers of Melanesian were a dark fuzzy-haired people. There are other languages which are descended from the same original as Melanesian, namely, Polynesian, Malay, Malagasy. The people who use these languages are nearly all light in color, straight-haired and somewhat Mongoloid, very unlike the Melanesian type. Where they are alike crossing is probable. Either, therefore, the Melanesian type borrowed its speech from the Malayo-Polynesian or *vice-versa*. The map most decidedly lends support to the first view . . .

The conclusion is that the original Melanesians, those who taught their tongue to the dark type now called Melanesian, were a light-colored, straight-haired people. It is much to be desired, therefore, that anthropologists should cease to speak of a dark, fuzzy-haired type as Melanesian, or trace a Melanesian immigration where they find a dark, long-headed strain among Polynesians. Perhaps indeed they are right in tracing Melanesian influence where there is a dark strain, but not in the way they think. I have shown that in Fiji a dark people moving eastward drove out a Polynesian-speaking people, possibly also speakers of Melanesian. I have suggested that the same movement has occurred all through Melanesia. The Melanesians, true Melanesians, thus turned out, have sailed east in quest of new homes, but not before they had been much permeated with black blood. . .That would explain how a dark strain is found in Polynesia which otherwise is a puzzle, since the so-called Melanesians are but coasters."

SUR LES RELATIONS DES NÉO-CALÉDONIENS AVEC LE GROUPE DE L'HOMO NEANDERTHALENSIS. By Sarasin (Fritz)—*L'Anthropologie*, 1924, XXXIV, 193–227.

The author's studies lead him to conclude that the New Caledonians are closely related to the Australians, Tasmanians and Melanesians in general. They may all be regarded as one group, the "Austro-Melanesian." This group, in Dr. Sarasin's opinion, is the most primitive of all the existing groups of *Homo sapiens*. But Dr. Sarasin goes much further, believing that this group offers a faithful picture of the ancestral forms of all the varieties of man of to-day. Not that the Austro-Melanesians show the exact form of our ancestors, for in the course of time they must themselves have suffered modifications; but the author believes that "of all the existing races of man to-day the Austro-Melanesian group represents most truly the ancestral form from which present humanity has descended." The Pygmy and Negrito races represent collateral "neotemic" branches of recent man. The Talgai man and the Rhodesian man are possibly indications of a preneanderthaloid strain from which descended both the Neanderthal and the Austro-Melanesian types. Properly, however, the author is cautious about a straight advocacy of such far-reaching hypotheses.

PRELIMINARY OBSERVATIONS ON THE NOSE OF THE AUSTRALIAN ABORIGINAL WITH A TABLE OF ABORIGINAL HEAD MEASUREMENTS. By Burkitt (A. N.) and G. H. S. Lightoller.—*J. Anat.*, 1923, LVII, Part 4, 295–312.

"The nose in the Australian aborignal is very broad and flat, and its cartilages correspond very closely to those of the negro in shape. The ala nasi probably lies altogether lateral to the bony apertura. In the aborignal the skull tends to be orygmocraspedote and has well developed praenasal areas, with the incisor teeth closely approximated to the nose. In all the skulls observed, whether of anthropoid apes, fossil type of man, of aboriginal, negroes, Melanesian or white type, the variations to be seen in the area praenasalis and the lower margin of the apertura piriformis, are due chiefly to the tooth pressure of the upper incisor and canine teeth. To estimate the tooth pressure one must take into consideration both the force, the frequency and mode of application of the bite, and the size, curvature and age of the teeth, the direction of their axes and the approximation of their apices and the margin of the apertura piriformis."

A CONTRIBUTION TO THE CRANIOLOGY OF THE YELLOW-SKINNED RACES OF SOUTH AFRICA. By Broom (R.)—*J. Anthrop. Inst.*, 1923, LIII, Jan.–June, 132–149.

"The oldest human types known from South Africa are the races represented by the Rhodesian Broken Hill skull and the Boskop skull. Each of these skulls is probably of great antiquity, but at present we have no evidence on this point, nor can we say which is the older. Not improbably the race represented by the Boskop skull are the direct but remote ancestors of the Bushmen of to-day. The Hottentots appear to have some affinity with the Boskop type, and may perhaps prove to be an admixture of a northern dolichocephalic race with a southern race such as is represented by the Boskop skull. The Korana, or perhaps one ought rather to say the eastern Hottentots appear to be Hottentots who have acquired some strain of negroid blood and a considerable strain from some Australoid race; this latter possibly being derived from the race represented by the Broken Hill skull."

A PSEUDO-MONGOLIAN TYPE IN NEGRO AFRICA. By Seligman (C. G.) —*Man*, Dec., 1924, XXIV, No. 12, 177.

The note calls attention "to the occurrence in the far southern Sudan (Mongalla Province) of a not inconsiderable number of healthy, mentally normal individuals having narrow eyes, often with a well-marked epicanthic fold." The type is not rare, and the writer has seen approaches to it also further north, and a similar type has been reported to him from northern Nigeria. As to the significance of this type, the author expresses himself as follows: "In the present condition of our knowledge I hold it improbable that the condition described has anything to do with Mongolian or even Bushman ancestry. Rather do I regard the occurrence of a more or less well developed type hitherto generally regarded as proper to the Yellow race (at least in adults) in a small but not negligible number of healthy Black Africans in Central and Western Africa as an interesting example of the independent origin of variations (as *e. g.*, hyperdactyly, though whether Negro pseudo-Mongolism tends to be hereditary I cannot say); an example which may even hint at the mechanism of race formation."

The reviewer is inclined to look at the phenomenon as rather a survival of a generalized ancestral, pre-negro, condition.

ASHANTI. By Rattray (R. S.)—348 pp. with chart and index. Oxford University Press, American Branch, 1923 ($7).

Most of the chapters of this valuable treatise deal with "social anthropology," or what in the United States would be comprised under

Ethnology. It is the result of "the first year's work of the new Anthropological Department in Ashanti, West Africa." In addition to "customs and beliefs," however, it brings also a note on "the measurements of the Ashanti made by the author and discussed by Dudley Buxton. The measurements extend to 48 men and 27 women and include stature, length and breadth of head, face, and nose, and minimum frontal with bignonial diameters. Principal results: Stature—m. 164.2, f. 154.7; C. I.—m. 77.5, f. 77.8; upper F. I.—m. 44.2, f. 42.6; total F. I.—m. 80.3, f. 78.1. The measurements indicate a remarkably homogeneous group, free from admixture.

The Batikara or Banyoro. By Roscoe (John)—Cambridge (England), 1923, xvi+370 pp., 42 plates and map.

The first volume of the Report of the Mackie Ethnological Expedition undertaken by the writer. It is a well written ethnographical account of the Banyore negroes of the Uganda Protectorate (eastern coast of Lake Albert), East Africa.

Chapters of interest to physical anthropology are those on Birth, Childhood, Marriage, Illness and Death. Some of the illustrations, also, are good, showing the types of the people.

THE AMERICAN INDIAN

Indian Burial Place at Winthrop, Massachusetts. By Willoughby (Charles). With Notes on the Skeletal Remains. By Hooton (Ernest A.)—*Papers Peabody Mus.* Harvard Univ., 1924, XI, No. 1, 8°, 37 pp., 21 figs. in text.

The skeletal material, ably described by Dr. Hooton, consisted of the incomplete skeletons of 7 adult males, 4 adult or subadult females, and 5 infants. The results show that "In addition to the usual tall dolichocephalic type of Eastern Indian there is present in this series a mesocephalic type due to admixture of a short brachycephalic stock. The evidence of this admixture is to be seen in the shortening of the skull, the increase of breadth across the posterior portions of the parietals, increase of the skull height, shorter face, and broader, lower nose. The measurements of some of the mesocephals and subbrachycephals are such as to make one suspect some occipital deformation. This, however, is not apparent from the contours of the occipital bones. In the short series from Winthrop this mixed type actually predominates."

Cranes d'Indiens de la Colombie. Lé'élment Papoua en Amérique. By Verneau (R.)—*L'Anthropologie*, 1924, XXXIV, No. 5, 353–385.

Professor Verneau, basing himself on the resemblances of some American with some Papuan skulls (more particularly one Tunebo skull from Colombia), feels justified in coming to the rather portentous conclusion that these similarities mean a considerable former occupation of parts of America by the Papuans. The idea of the presence of Melanesian elements in America is an old one with the French authors (*v.* Quatrefages), but it was never formulated so definitely. In the words of the author (p. 382) "it now seems no more permissible to doubt a great extension of the Papuan type in the New World. Its traces have been followed in space from Lower California to the southern extremity of the continent and from the Pacific to the Atlantic, and in time from the epoch when the race inhabited Lagoa-Santa to our day."

To those of us who have had, and, in our vast collections still have, the greatest facilities for the study of these questions, the above opinion, however we may respect the deserving author, appears to be but an illusion. Similarities of skulls have no more the value they once seemed to possess and normal variations of different racial groups overlap more or less. Otherwise we should have to come to the conclusion that we had in pre-Columbian America representatives of practically every race now living and some ancient.

LAS CASTAS DEL MEXICO COLONIAL. By Leon (Nicolás)—small 8°, Mex. 1924, 76 pp., numerous ill's.

The rich and complicated subject of mixed-bloods in Mexico is once more dealt with and that more comprehensively than before. A large number of plates showing graphically the blood composition of the various recognized mixtures is particularly welcome. Attention is called to the fact that new varieties of "mestizos" are now arising in Mexico as a result of recent immigrations, particularly due to the coming of the Japanese.

THE THIRTY-THIRD ANNUAL ARCHAEOLOGICAL REPORT OF THE MINISTRY OF EDUCATION, ONTARIO, CANADA brings, as usual, a number of items of more or less interest to physical anthropology. These are: Boundaries of the Huron Tribes (with maps); Accounts and Estimates of Huron Population; Huron Migrations; Huron Burial Customs; Algonquin sub-Tribes of Ontario; and Red Paint Burial in Ontario.

CRANIOLOGY

THE PRINCIPAL MORPHOLOGIC TYPES OF THE SKULL AND THEIR EVOLUTION. (In Russian and French.) By Bunak (V.)—*Russ. Antrop. Jur.*, Moscow, 1922, XII, 6–56.

An ingenious study of a highly complex subject. Some of the conclusions are: The cephalic and also the vertical indices alone are insufficient to express the type of a skull, and with the same index, skulls may differ in type. The volume is also of but little help. A more effective classification of skulls may be obtained by a synthesis of all their main characteristics and especially the dimensions of their principal diameters. Proceeding in this way, the author arrives at 9 basic forms: (1) The narrow or *stenoid;* (2) of medium breadth, or *paraeuroid;* (3) broad, or *euroid;* (4) the short skulls, or *brachyoid;* (5) of medium length, or *mesoid;* (6) long, or *dolichoid;* (7) the low, or *cathoid;* (8) of medium height, or *orthoid;* and (9) high, or *hypsoid.* The limits of these subdivisions must naturally be based on the ranges of variation of the three diameters in the human skull. Any one of the types of a single dimension may be combined with any two of the other dimensions, making possible 27 combinations. Thus, a skull may be stenoid, dolichoid and hypsoid (*sdh*); or stenoid, mesoid and orthoid (*smo*); etc. The method is both practical and promising. The predominant type in a series naturally will characterise that series, and the total results on a group will afford valuable data for an analysis of the group as well as for comparison. Examples of such results are given. The method alone will not suffice for racial classification, but will be helpful in that direction. It will also be helpful in comparisons with and study of early man, and in studies of the evolution of the skull.

A study of the variability of the three main diameters of the skull shows that the breadth is somewhat less variable than the length or the height. The evolution of the skull, according to all indications, was very complex.

DIE SONDERFORM DES MENSCHENSCHÄDELS ALS ANPASSUNG AN DEN AUFRECHTEN GANG. By Weidenreich (F.)—*Zeitschr. Morphol. & Anthrop.*, 1924, XXIV, 157–189.

In the same original manner in which the author had approached the problems of the pelvis and of the foot skeleton of man he deals in this stimulating paper with the peculiarities of the human skull due to upright posture. The different relations between the axes of the brain and of the spinal cord in different vertebrates, and particularly mammals, show the striking influence of posture. The curve of the human skull base is considered as a kyphosis in the cranial vertebrae which acts as a compensation for the lordosis in the cervical spine. In Cetaceae just the reversed condition is found, namely a lordosis of the skull base and a kyphosis of the adjoining spinal region. In the human newborn, where the cervical curve is not as yet formed, the skull base is less bent than in the adult. In close connection with the kyphosis of the human cranial vertebrae stand various other conditions, typical for man. Here may be mentioned the general crowding of the structure near the center of the kyphotic curve—the base, and the expansion at the periphery—the roof of the skull. By superimposing the skulls of a quadruped an ape and man so that the planes of their foramina magna coincide, the changes in the skull are clearly demonstrated, particularly the lowering of the face in the ape and still more so in man, which becomes possible through the flexion of the skull base. Based upon this choice of the plane of the foramen magnum as the biological horizon for orientation, the author argues that one can not properly speak of a shifting of the foramen magnum but that the latter is always "centrally" situated while the degree of flexion in the axis of the brain-case changes with the acquisition of erect posture.

A. H. SCHULTZ.

Betrachtungen über die Schädelform des Menschen. By Fischer (E.)—*Zeitschr. Morphol. & Anthropol.*, 1924, XXIV, 37–45.

Skull length and skull breadth—but not their relation to each other, the cephalic index—are inherited strictly according to the Mendelian rule, just like other characters, such as statute or skin- eye- and hair-color. The fact that the variations in these skull diameters in some races are occasionally not found in the theoretically expected distribution is explained by the author as due to direct environmental influences rather than to selection by mortality or migration.

A. H. Schultz.

The Brachycephalic Skull. By Parsons (F. G.)—*J. Anthrop. Inst.*, 1924, LIV, 166–182.

"The present paper is a study of brachycephalic skulls, partly carried out by comparing dioptographic sketches one with another and partly by reducing the whole series to composite sketches from three points of view." The material at the author's disposal (30 adult male skulls of European whites) suggests to him the following conclusions: That the brachycephalic skull is both shorter and broader than the dolichocephalic, but that its decrease in length is greater than its increase in breadth. That the dolichocephalic skull is longer by increased growth in its posterior part. That the brachycephalic skull is wider chiefly by growth in its temporal regions. That short European skulls are usually more prognathous than long ones. That when the nasal width is compared with the whole area of the face, brachycephalic skulls are distinctly broader-nosed than dolichocephalic are. That when the orbital height is compared with the whole area of the face the orbital openings are not so high in the brachycephalic as in the Nordic skull."

Schädelform und Vererbung. By Fischer (E.)—*Münchner Med. Wochenschr.*, 1923, No. 50, 1475–1476.

A series of rats, 5–6 weeks old, were kept for 5–8 more weeks on a diet lacking completely vitamine A. The length-width indices of their skulls ranged from 38.8 to 46.7, whereas in normal rats this range extends from 32.9 to 38.0. Younger normal rats (6–8 weeks) show a range in this character from 42 to 43.7. The vitamine-deficient rats are generally undersize and their high cephalic index may be partly a persisting infantile condition. However, this difference in size does not alone explain the great difference in the relative width of the skull. By the latter the author seems to have proven that the skull-shape can be modified in a chemical way; however, this important experiment, based as it is only upon 25 abnormal rats, might well be controlled on larger series.

A. H. Schultz.

Schädelform und Vererbung. By Fischer (E.)—*Z. f. induktive Abstamungs-& Vererbungs Lehre*, 1924, XXXIII, 347.

A preliminary notice, same as preceding. Experiments in animals under the author's direction have resulted in the production of shorter skulls. The experiments were partly mechanical, consisting of the severing of the temporal and nuchal muscles, and partly nutritional, or strictly speaking chemical, through the abstraction of certain vitamins. A detailed report is soon to follow.

BEITRAG ZUR ANTHROPOLOGISCHEN BEURTEILUNG DES SCHÄDELS VOM NEUGEBORENEN, INSBESONDERE DER SCHÄDELBASIS, NEBST BEMERKUNGEN ÜBER SYMPTOMATISCHE UND KAUSALBIOLOGISCHE ARBEITSMETHODEN IN DER ANTHROPOLOGIE. By Pfuhl (W.)—*Anatom. Anz.*, 1924, LIX, 33–80.

Measurements, appertaining chiefly to the base of the skull, on 20 fresh skulls of newborns, and discussed in detail. A comparison is drawn between the dimensions of these fresh skulls and those taken on 7 dry skulls of newborns and between the measurements of a newborn skull when fresh and moist and later when dried. It is thus shown that in drying, these small skulls shrink considerably in almost all dimensions, including those of the base, and that, *e. g.*, the cephalic index tends to become unnaturally high. From this it again appears that skulls of newborns and infants should not serve for craniometric studies unless kept moist or, better still, examined immediately after removal from the body. The author reduces all his measurements to a modulus obtained from the average of the square roots of the products of a certain combination length (nasion—basion+basion—inion) and a certain combination width of the skull base. Such a tendency is not new but it is still doubtful whether this complicated method is really superior to well-selected indices. The high-sounding and lengthy discussions on general methods, trends and values of biological and morphological anthropology are rather vague and based upon many unsupported hypotheses. In the author's condemnation of the "old" morphological methods he forgets that a method should only be criticised in connection with the purpose for which it is employed.

A. H. SCHULTZ.

THICKNESS OF THE MALE WHITE CRANIUM. By Todd (T. Wingate)—*Anat. Rec.*, 1924, XXVII, No. 5, 245–256.

Basing himself on the study of 448 male white crania of known age, the author reaches the following conclusions: "Average thickness in male white crania is given by the following figures: Glabellar area, 11.3 mm.; Opisthion, 5.7 mm.; Vertex, 5.9 mm.; Euryon, 3.6 mm. Cranial thickness increases slightly with age up to about sixty years, but thereafter there is no real evidence of any normal change. Cranial thickness is so variable that it appears unreasonable to imagine it under specific natural control as many dimensions seem to be. It is so variable that one may not expect to predict it with a real degree of accuracy for any particular cranium. Segregation of crania upon a basis of the relation of capacity to linear dimensions indicates at least four types of male white skulls, of which the most finely modelled and best filled type has cranial walls significantly thinner except at the Euryon than those of the lowest type. Cranial thickness is of the same order of variability as scalp thickness."

The Nature of Mummification and Maceration Illustrated By the Male White Skull. By Todd (T. Wingate)—*J. Anat.*, 1925, Part II, LIX, 180–187.

A series of 49 male White skulls has been subjected to mummification and later to maceration, measurements being made weekly. "Shrinkage in mummification is complete in eight weeks and equals between 0.6 and 0.8 per cent of the final mummified cranial dimensions. After maceration the cranial dimensions scarcely reach their original value, but, on the average, they come at least to within 0.3 mm. of the green dimensions. After maceration shrinkage is complete in four weeks and the difference in measurement of the dried macerated cranium from the dimensions of the green skull varies from 0.8 per cent to 1.0 per cent of the final dried cranial measurements. Mummification, maceration and drying after maceration represent, for practical purposes, merely variations in the water content of the bones. No unforseen factors influence the cranial dimensions as a result of these procedures. In its dry stage the cranium is sensitive to changes in atmospheric humidity, but the alteration in dimension due to this cause is negligible."

CRANIAL PARTS

The Cranio-Facial Axis of Huxley. Part I. Embryological Considerations. By Cameron (John)—*Trans. R. Soc. Canada*, Sec. V, 1924, 115–123.

"The flexion of the cranio-facial axis has not received due recognition in textbooks of embryology. This flexion occurs in the region of the pituitary fossa of the basis cranii, which is thereby conveniently divided into pre-pituitary and post-pituitary segments. The salient point of the angle of cranial flexion is situated on the anterior margin of the pituitary fossa (pituitary point). Huxley was in error in choosing the prosphenion as the salient point of his spheno-ethmoidal angle, which was meant to demonstrate the degree of flexion of the basis cranii. The author's 'main angle of cranial flexion' is represented by lines joining the basion and the nasion to the pituitary point. These two lines ought also to be used to represent the human cranio-facial axis. These conclusions will be found to be confirmed by comparative anatomy."

Zur Anthropologie der Nase. By Virchow (H.)—*Z. Ethnol.*, 1924, Jahrg. 56, 94–111.

A great variety of very detailed remarks concerning the nasal skeleton, particularly the points of measurement and variations in form of the borders of the apertura piriformis. There exists no constant relation between outer nose and bony nose; for instance, in 29 cases in which the author obtained the width of the outer nose and of the underlying apertura the latter ranged from 21 to 31 mm. the former from 21 to 51 mm.

A. H. SCHULTZ.

MAN'S NASAL INDEX IN RELATION TO CERTAIN CLIMATIC CONDITIONS. By Thomson (Arthur) and L. H. Dudley Buxton.—*J. Anthrop. Inst.*, 1923, LIII, Jan.–June, 92–122.

The evidence "leads the authors to the belief that a platyrrhine nasal index is associated with a hot moist climate, and a leptorrhine nasal index with a cold dry climate, the intermediate conditions being associated with hot dry and cold moist climates. There is a positive correlation both on living males and on crania between the nasal index and the temperature. On living males there is also a positive correlation between the nasal index and relative humidity. On crania this correlation, although present, is small. In order to test these results, reconstruction formulae were calculated whereby from a knowledge of temperature and humidity the nasal index on the living and on crania can be calculated and compared with actual observations. Attention has also been drawn to the correlation between nasal indices on the living and on crania. Finally, there is suggested the possible application of conclusions arrived at on modern peoples to the study of the prehistoric inhabitants of Europe and to the problem of migrations."

THE CRESTS ON THE SKULLS OF PRIMATES. By Bunak (V.)—*Russ. Antropol. Jurn.*, Moscow, 1923, XII; also *Anthropologie*, (Prague), 1924, II, 131–4.

Neither the sagittal nor the lambdoid crest is wholly the result of the mass and extent of the temporal muscles, for when we compare the conditions in the males and females and study the relation of the crests to the development of the lower jaw, to that of the exact extent of the temporal muscles and to that of the size of the canines, we do not meet with full correspondence. It is necessary to regard these crests first of all as systemic characters of certain species of the Primates; in the second line as secondary sex characters; and only in the third line as proportionate to the development of the temporal and nuchal muscles.

DIE BEDINGUNGEN ZUR BILDUNG VON KNOCHENKÄMMEN AM SCHÄDEL DER PRIMATEN. By Mollison (Th.)—*Sitz. Heidelb. Ak. Wiss.*, 1919, 3 Abh. (9 pp.)

A development or an absence of the cranial crests is no criterium of relationship among the Primates. Neither can any phylogenetic significance be attached to an ontogenetically late development of the crests. These formations or their absence are connected on one hand with the development of the nuchal muscles and those of mastication, and on the other with the development of the brain. The larger the muscles and the smaller the brain, the greater is the tendency towards the development of these crests, and *vice versa*.

THE NORMAL AND PATHOLOGIC ANATOMY OF THE SELLA TURCICA AS REVEALED BY ROENTGENOGRAMS. By Camp (John D.)—*Am. J. Roentgenology*, 1924, XII, No. 2, 143–156.

"Careful technique is necessary to produce roentgenograms of the sella which are free from psuedo-defects and anomalies. The normal sella varies greatly in contour, but such variations may be classified into three types; the oval, the round and the flat; the oval type predominates (about 60 per cent). The size of the normal sella varies greatly, and in view of such normal variations it is difficult to recognize, in the roentgenograms, early pathologic changes in its size and contour. (The minimal anteroposterior distance found in the roentgenograms examined was 0.5 cm. and the maximal measurement was 1.6 cm. The depth measurement was found to vary between 0.4 cm. and 1.2 cm.) The average normal sella, as revealed in the roentgenograms of this study, measured 1.06 cm. and 0.81 cm. in the anteroposterior and vertical directions respectively. Normal variations in the shape of the clinoid processes are not uncommon, and bony union between the anterior and posterior clinoid processes, producing a "bridged sella" exists in about 5.5 per cent of the cases. Such an anatomic variation seems to be of no clinical significance. Owing to the characteristic deformity of the sella produced by each, the distinction between intrasellar and extrasellar tumors is possible. The localization of extrasellar tumors by differentiation of sellar deformities, alone, is impossible. Anatomic specimens always reveal more bone destruction than can be recognized in a roentgenogram."

TEETH

TEETH AND JAWS IN PREHISTORIC MAN, AND DENTAL ANOMALIES. *La Semaine Dentaire*, Paris, 1924, VII, brings in the course of the year the following articles of interest to students of teeth from the more anthropological standpoint:

PREHISTORY: A propos de l'abrasion des dents. Recherches à faire sur l'usure néolithique. (Dr. M. Baudoin, No. 4, Jan. 27.). La signification véritable des mutilations dentaires ethniques et préhistoriques. (Baudoin, No. 33, Aug. 17; No. 34, Aug. 24). Contribution à la radiographie des maxillaires préhistoriques. (Baudoin & A. Bouland, No. 37, Sept. 14). Lésions osseuses préhistoriques de la Vendée. (Rouillon, No. 46, Nov. 16).

ANOMALIES: Dents à la naissance. (J. A. Puis, No. 18, May 4.) Absence de toutes les dents permanentes excepté des premières molaires du maxillaire supérieur. (E. Samuels, No. 19, May 11.) Deux observations sur l'évolution tardive de deux canines. (E. Anquetil, No. 26, June 29.) Contribution à l'étude des accidents dus à l'évolution de la dent de sagesse. (Dr. Gignoux, No. 26, June 29.) Un cas de kyste dermoïde de l'ovaire. (Drs. Godart & A. Bouland, No. 26, June 29.) Etiologie des anomalies dento-maxillaires (R. Boissier, No. 45, Nov. 9). Anomalies de l'articulation en rhinologie et thérapeutique. (Prof. B. de Vecchis, No. 50, Dec. 14; No. 51, Dec. 21.)

DENTS A LA NAISSANCE. By Pires de Lima (J. A.)—*Bull. & Mém. Soc. Anthrop.*, Paris, 1923, IV, fasc. 1, 2, 3, 71–74.

The author reports several cases of teeth in newborn infants or within a few days or weeks after birth. In some of the instances the condition was apparently of hereditary origin. Added is a brief discussion of formerly reported cases of this nature.

ESSAI SUR LA PREMIÈRE DENTITION. By Ledé (Fernand)—*La Semaine Dentaire*, 1924, VI, No. 8, 204–208.

The author, basing his prolonged observations on no less than 3,012 children, or 28,694 teeth, arrives at some very interesting results, particularly as to the effects of norishment. They are as follows:

ERUPTION OF TEETH OF FIRST DENTITION

	Infants of Wet Nurses without Nurselings		Infants of Wet Nurses with Nurselings		Nurselings	
	Months	Days	Months	Days	Months	Days
			Lower Jaw			
Incisors, median, right	7	19	8	8	9	..
" " left	7	23	8	20	9	..
" lateral right	13	..	13	12	14	9
" " left	13	5	13	14	14	18
Canine, right	18	11	19	5	19	12
" left	18	24	18	24	19	14
Anterior premolar, right	15	21	15	26	16	25
" " left	15	21	15	17	16	16
			Upper Jaw			
Incisors, median, right	9	15	10	10	10	25
" " left	9	13	10	6	11	5
" lateral right	11	3	11	28	11	29
" " left	11	8	12	1	11	27
Canine, right	18	18	18	23	18	23
" left	18	19	18	21	18	20
Anterior premolar, right	14	28	15	2	16	17
" " left	14	20	15	1	15	24

	Infants Fed Artificially		General Average	
	Months	Days	Months	Days
		Lower Jaw		
Incisors, median, right	9	24	8	4
" " left	9	25	9	8
" lateral right	15	16	14	20
" " left	15	3	14	18
Canine, right	20	9	19	29
" left	20	7	19	26
Anterior premolar, right	17	12	16	13
" " left	17	11	16	26
		Upper Jaw		
Incisors, median, right	12	19	10	24
" " left	11	21	10	19
" lateral right	13	9	12	2
" " left	13	15	12	3
Canine, right	19	24	18	29
" left	19	27	18	23
Anterior premolar, right	16	23	15	25
" " left	16	24	15	17

TEETH AND SEX. By Dobkovsky (T.)—*Zahnaertzl. Rundschau*, Leipzig, 1924, XXX, No. 35.

"The author has studied this subject in the Orthodontic Laboratory of the University of Leipzig under Professor Pfaff, with special emphasis on cases of sex confusion—effiminate men and masculine women; his object being to determine whether the teeth are in any sense a secondary sexual characteristic like the hair, the fat distribution, etc. It is generally admitted that sex differences are normally present to some extent—thus males have much larger canine teeth than females. In general the incisors as a whole are larger in the male. In the bicuspids and molars the differences are much less striking. We may therefore speak of male and female dentition types, although a woman with a male type of teeth is not at once to be set down as inclined to masculinism.

The author investigated 132 cases of so-called homosexualism in which the sex was physically inverted irrespective of physical peculiarities. He selected for study those who also presented the physical habitus of the opposite sex. He made elaborate control measurements of the first and second incisors and canines of both upper and lower jaws of 100 normal men and 100 normal women and then having made similar measurement of a large number of markedly effeminate men he was able to show that the average size of these teeth was intermediate between that of normal men and normal women. Naturally the differences which are present only as millimeter-tenths, are very slight. The discovery, if such it may be termed, is of little practical value, although the author suggests that since these teeth are all developed before puberty we may be enabled at times to forecast the likelihood that a boy will become effeminate during adolescence, or a girl prove to be of the virago type." (*Intern. J. Orthodontia*, 1924, X, No. 12, 820.)

AN ABNORMAL SKULL FROM NEW GUINEA WITH REMARKS ON THE STRUCTURE OF THE MANDIBLE. By Gullberg (J. Ekblem) and A. N. Burkitt—*J. Anat.*, 1924, LIX, Part I, 41–55.

"The skull cannot be placed in any known category, as far as we are aware, and presents the following outstanding features: symmetrical enlargement of the body of the lower jaw, excepting the alveolus; a definite shallowing of the teeth sockets in both upper and lower jaws; and an upgrowth of bone into the pulp cavities of certain of the teeth. Of these features the growth of bone into the pulp cavities of the anterior mandibular teeth is, we believe, quite unique and has not hitherto been observed."

THE DENTITION OF THE WESTERN AND CENTRAL ESKIMOS. By Ritchie (Stephen G.)—*Rep. Canadian Arctic Exp., 1913–18*, XII, The Copper Eskimos. c59–c67, 9 pl., Ottawa, 1923.

Dr. Ritchie reports on the dental arches and teeth of the skulls described in the same Report by Professor John Cameron.

The arches are broad, short, semi-elliptical, symmetric. The occlusion is edge-to-edge. The occlusal plain flat or faintly curved from before backward. Premolar and molar cusps are usually low. Wear is rapid and pronounced, but alveolar abscesses are apparently unknown, the pulp chamber having been obliterated by new dentine. There is not the slightest trace of caries (26 crania and some fragments) and the same is true of pyorrhoea or alveolar resorption. Salivary calculus was wholly absent with one exception. The glenoid fossae are shallow, broad, eminentia articularis flattened. In dimensions the Eskimo teeth tend to be greater than those of the civilized races. This is particularly true of the molars, which also "tend to revert to the generalized mammalian type where the molars increase in size in the antero-posterior direction. The teeth as a whole are more symmetrical and stick closer to the ideal typal forms than do those of the white races. There is in these jaws no signs of extremes in root development; nor, with the exception of the third molar where variation is world wide, is there any indication of the fusion of molar roots spoken of by Wingate Todd as common in the Eskimo...In my opinion in individual Eskimo teeth there is far less variation from the mean than in any of the civilized races, and in this race we have the finest typal forms of teeth and the best dentition in the world. Owing to their food habits I am strongly inclined to think that during the lapse of time not only the jaws but the teeth have been growing progressively larger...An examination of the maxillary sinuses shows that in no case is there a projection of the roots of the molars or premolars into them. It was further noted that these sinuses are extremely large, with walls so thin as to be translucent;" they may possibly "act as reservoirs for warm air which would aid materially the mucous membranes of the nose in the process of respiration when the temperatures are low."

"In the mandibles of adult individuals a pronounced reinforcement of the alveolar process on the lingual sides of the premolar teeth which gradually vanishes as the molar series is reached is to be noted." This the author regards as a compensational effect to the torsional stress exerted upon the jaw by the muscles of mastication. The lower 2nd molar frequently carries 5 cusps. Eruption of permanent teeth is apparently earlier than in civilized man. Measurements of the teeth and arches are added.

MORPHOLOGICAL MALOCCLUSIONS. By Szombathy (J.)—*Sitz. Anthrop. Ges.*, Wien, 1922–3.

In a lengthy discussion of Dr. H. Sicher's communication on the "Analysis of the Characteristics of the Teeth and Jaws," the author accentuates the fact that in dental malocclusions or jaw disharmonies of morphological (not pathological) nature it is essentially the upper jaw that has undergone the changes, the lower jaw possessing much greater stability.

LA CARIE DENTAIRE IL Y A DIX MILLE ANS. I. ÉTUDE DES CARIES DE LA CISTE DES COUS A BAZOGES-EN-PAREDS (VENDÉE). By Baudouin (Marcel)—*La Semaine Dentaire*, 1923, V, No. 19, 444–453.

A study of the teeth of the Neolithic short-statured dolichocephals of the dolmens, has shown that caries existed, even if infrequently, in both adults and children. Moreover, the evidence proves that the disease commenced always on the cervix of the tooth and that on the anterior or posterior (distal and proximal), never on the lateral surfaces. There was not a single exception to these rules. The causative agency was evidently interdental traumatism. There was a form of wear characteristic of Neolithic remains.

Incidence of Caries in the Different Teeth and their Respective Surfaces. By Leigh (Rufus W.)—*The Milit. Dent. J.*, 1923, VI, No. 4, 183–194.

"There is a marked difference in susceptibility of the different teeth to caries. The lesion is usually located in definite areas of certain teeth. The first molars are the most susceptible; and the mandibular first molar is 2.36 times as susceptible as the maxillary first molar. The mandibular anterior eight teeth are highly resistant to caries; the average susceptiblity of these teeth as compared with the most susceptible tooth is as 1 is to 39. The resistance of the maxillary cuspid is high; its susceptibility to caries when compared with the mandibular first molar is as 1 to 29. The occurrence of caries is bilaterally symmetrical. The incidence of caries is slightly greater on the left than on the right side in both the maxilla and mandible."

Progress in Dental Hygiene: Dental Caries and Its Causation. *Internat. Clinics*, Sept., 1924, repr. 28 pp.

"Dental caries is probably the most prevalent pathological condition consequent upon civilization. Tissue invaded by this morbid process is permanently destroyed. Much of the pathology of the oral tissues is directly or indirectly the result of caries. Many predisposing causes of caries are known, chief among which is the character of the diet. The exciting cause of dental caries is bacterial in nature, but a specific micro-organism has not yet been found. The occurrence of caries varies with the morphology of the teeth and age of the person. The sequelae of dental caries is widely variant, and may be far reaching in the body economy."

BONES OF THE SKELETON

Backache from Vertebral Anomaly. By Willis (Theodore A.)—*Surgery, Gynecol. & Obstetrics*, May, 1924, 658–665.

"Though the human spinal column is the most stable of the primate columns, it still presents frequent variations from the modal type. These variations result from an evolutionary shortening of the column by cephalad progression of the pelvic girdle complex upon the column. The articulation of the girdle with the column is, therefore, a region of morphological instability as evidenced by the frequent occurrence of development anomalies. Spinal columns thus affected are predisposed to mechanical derangement the symptoms of which are essentially ligamentous in origin.

The anomalies may be divided into two groups one of which involves the last lumbar segment alone, the other affects the articulation between this segment and the first sacral. The former includes various types of interruption in continuity of the neural arch and the atypical transverse process. The defect of the arch is responsible for the occurrence of spondylolisthesis and kindred disorders. The latter group comprises the abmodal developmental formations of the articular processes. Each group gives rise to definite clinical syndromes. The form of treatment and prognosis depend upon the individual case."

Numerical Significance in the Thoracicolumbar Vertebrae of the Mammalia. By Todd (T. Wingate)—*Anat. Rec.*, 1922, XXIV, No. 5, 261–286.

"The following accepted ideas regarding the presacral vertebral column in mammals are undoubtedly correct: The primitive mammalian number of thoracicolumbar vertebrae is and always has been nineteen. In most orders of mammals there is a tendency to increase this number (Welcker's auxispondylous group). In Primates the tendency is to reduce the number, the anthropoids and Man forming Welcker's lipospondylous group. So far as the thoracicolumbar column is concerned, Man takes his place between the gibbons and the giant black anthropoids. The lemurs form the connecting link between the Primates and other mammalian orders. Whereas some in their specialization exhibit an increase in number like the auxispondylous mammals, there are others which lean towards the typically higher Primates in their tendency toward reduction in number of thoracicolumbar vertebrae. The relation of vertebral formula to specialization in the lemurs is quite significant. The New-World monkeys show a greater tendency towards reduction in number, but here also there is marked bias towards increase in number, as in many lemurs. The primitive number nineteen is characteristic of both subfamilies of Old-World apes, only rare examples showing an increase to twenty. The anthropoids and Man exhibit progressive reduction in number, but of all this group man presents by far the most stable condition numerically in his vertebral formula. The precise stability for Man is strikingly given in the recent work by Willis."

The Lumbo-Sacral Vertebral Column in Man, Its Stability of Form and Function. By Willis (Theodore A.)—*Am. J. Anat.*, 1923, XXXII, No. 1, 95–123.

"Comparison of mammalian vertebral columns shows evidence of an evolutionary shortening of the column in the Primates. The human column, however, has a relatively high degree (95.8 per cent) of stability with a modal thoracico lumbar number of 17. The lumbar portion of the column adjacent to the sacrum presents certain morphological defects described as bifid and separate neural arches, the latter occurring three times as frequently as the former. Both defects result in weakness of the column, the bifid arch by impairing ligamentous attachments; the separate arch through loss of bony anchorage of the column to its base. Either defect may be dormant until put to test by severe stress or trauma. The bifid arch is due to arrest of development before fusion of the laminae takes place; the separate arch to irregular ossification with interruption of bony continuity. Muscular strains, lumbo-sacral sprains and spondylolisthesis often accompany these developmental defects, but may also be dependent upon malformations of the articular processes."

THE THORACICOLUMBAR COLUMN IN WHITE AND NEGRO STOCKS. By Willis (T. A.)—*Anat. Record*, XXVI, 1923, No. 1, 31–40.

"Numerical variability in the thoracicolumbar column is greater in Negroes than in White Stock. The variability in both, however, occurs round a common modal value.

No evidence is adduced in this work to indicate that the pelvis of the Negro is postfixed compared with that of the White. Nor does the type of variation suggest this as likely. It is probable that there is a clearly defined human type of column and a human range of variability differing quite plainly from the various anthropoid types and variabilities.

Such evidence as presents itself in favor of a tendency to reduction of the thoracicolumbar column in the female must be received with the greatest caution. It is unlikely that this would be confirmed by the study of a more numerous series."

UEBER UNVOLLSTANDIG ASSIMILIERTE LETZTE OCCIPITALWIRBEL BEIM MENSCHEN. By Bolk (L.)—*Anatom Anz.*, 1922, LV, 156–162.

Two new variations in the manifestation of the occipital vertebra are described; these represent an incomplete assimilation of the latter vertebra. The first group consists of cases with a long slender process pointing from the anterior end of one condyle towards the opposite side. This process corresponds, in the author's opinion, to the hemal arch of the last vertebra which has become assimilated with the occipital bone; normally, only these arches were taken into the skull, while the body of the vertebra became reduced, being represented by the rare condylus tertius. The second group is composed of skulls with a free process running posteriorly from the condyles and representing the dorsal arches of the occipital vertebra.

A. H. SCHULTZ

MORTALITY ACCORDING TO SPINE LENGTH.—At the recent meeting of the Association of Life Insurance Medical Directors held at Newark, N. J., the second report of the Committee on Dreyer measurements was presented. This Committee has for several years attempted to discover the relationship between longevity, on the one hand, and certain physical measurements, on the other. These measurements include height, weight, chest circumference and spine length, among others. The problem has been to determine what types of build involving these measurements are associated with the lowest mortality.

The latest report bears particularly on the significance of spine length on the mortality of overweights. The results are still rather confusing. Overweights show a higher mortality than the average build; but short overweights and those of medium height are different from those who are tall. In the first two classes, those with relatively short spines have lower mortality than those who have relatively long spines. Among tall overweights, on the other hand, those with relatively long spines have the better mortality. There can be no mistaking the difference between the two groups in view of the reliability of the material. It is to be noted that the higher mortality results primarily from higher rates for diabetes and the cardiovascularrenal diseases. Why is it that short men and those of medium height should behave so differently from tall men on the score of their spine length, it is difficult to say, and further investigation is called for to clear this point up. Possibly, it will be necessary to consider in future investigation not only the element of the relative spine length of overweights, but also the chest capacity. The Committee of the Association of Life Insurance Medical Directors will, therefore, continue the investigation and include the chest measure as an additional factor. (*Statist. Bull.*, Met. Life Ins. Co., 1924, V, No. 11).

THE SACRO-ILIAC JOINT. By Brooke (R.)—*J. Anat.*, 1924, LVIII, Part 4, 299–305.

"The old description, that the joint was an amphiarthrosis, was the description of a pathological change. The normal joint is of the diarthrodial type and in all probability takes part in movements backwards and forwards of the lumbar spine. Male and female joints are quite distinct in function and mobility for whereas the former are built for strength, aided by the presence of extra- and intra-articular tubercles, the latter is altered to meet the requirement of parturition by an increase in mobility, thereby assisting in the enlargement of the pelvic brim, to accomodate the passage of the foetal head. This it does by movements in a transverse direction as well as the rotatory movement described by Walcherew. The joint cavity itself is well defined with a continuous fringe of synovial membrane, and, at times, the addition of an accessory limb. It is a diarthrodia joint resembling in every characteristic any other joint of this type, becoming amphiarthrodial only under certain pathological conditions."

AGE CHANGES IN THE PUBIC SYMPHYSIS. VII. THE ANTHROPOID STRAIN IN HUMAN PUBIC SYMPHYSES OF THE THIRD DECADE. By Todd (T. Wingate)—*J. Anat.*, LVII, 1923, Part 3, 274–294, 12 plates.

The article forms a supplement to those published in the AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY (III, No. 3, 285–334 and IV, No. 1, 1–70). The author presents the following summary:

"The human pubic symphysis presents a Eutherian metamorphosis in modified form as a result of the permanent separation of the two pubic bones.

"Pubic metamorphosis in the giant Anthropoids is the connecting link between the human and the more typical Eutherian form. The epiphysial remnants of the human symphysis, namely ventral rampart, upper extremity and to a less and more variable extent the lower extremity, are the homologue of median bar and upper and lower nodules of typical Eutherian metamorphosis.

"Among human symphyses, both White and Negro, there exist two well defined types of metamorphosis. The first has the epiphyseal remnants obtrusively developed with consequent modification and even inversion of the phase-age relationship as originally enunciated. The second shows little or no independent epiphyseal formation and is the modal type in both human stocks. The first of these types is clearly related to one form of metamorphosis as shown in the giant Anthropoids and therefore is called the anthropoid strain. The second is named the regressive type of human metamorphosis. Between these two modes there is an intermediate type of metamorphosis which serves to link the other two.

"The three types occur in Whites as in Negroes but are more strikingly distinguished in the latter. There is no great difference in relative frequency.

"Examples of both the anthropoid strain and the regressive type may be accelerated or retarded in time relationship and such examples differ in their exact features according to the type to which they belong.

"In addition actual retrogressive examples of each type occur; these often present anomalies of outline or of surface contour in addition to the retrogressive features of the symphysial face.

"In estimating age by the symphysis one must be cautious in evaluation of the several symphysial features, those of the pubic bone itself being much more reliable than the various epiphysial remnants. If the type is clearly distinguished however these remnants are of distinct help in coming to a correct conclusion."

On the Sexual and Racial Characters of the Human Ilium. By Derry (D. E.)—*J. Anat.*, LVIII, Part 1, 1923, 71–83.

"The work upon which this paper is based was undertaken in the first instance with the idea of showing that certain characters of the human ilium visible to the eye and of value to the anatomist, as aids in sexing the bone, might also be measured, and so be of interest to the statistician. But as the work proceeded it became evident that the influence of race had such an important bearing on the question that it was impossible to ignore it. In the following account which deals with measurements on the English hip-bones from the Whitechapel plague pits as well as bones from different periods in Egypt and certain hip-bones from Dr. Geo. Reisner's excavations at Kerma in the Sudan, the various groups mentioned are dealt with separately.

The results of the measurements obtained from the ilium justify us in considering this portion of the hip-bone to be of great sexual importance, while the racial factor appears to be of sufficient influence to necessitate the rigid separation of the different groups

There is an inherent tendency towards the formation of a sexual type, which as growth proceeds becomes more pronounced, from the influence of body weight, muscular development and probably in the case of the woman, function, as represented by child bearing."

The facts however seem to point to body weight as an important factor in the production of the different forms of the ilium in the two sexes.

A COMPARISON BY STATISTICAL METHODS OF CERTAIN EXTERNAL PELVIC MEASUREMENTS OF FRENCH AND AMERICAN WOMEN. By Adair (Fred L.)—The *Am. J. of Obstetrics & Gynecol.*, II, No. 3, 1921, 3–26.

"The racial and national pelvic differences should be more carefully studied and recorded so that observations made and conclusions drawn in one section of the world may not be applied too arbitrarily in other sections. There are apparently definite pelvic differences, not only in different races, but in different nationalities. This was indicated by the earlier work of Verneau and Vrolick. It is shown definitely by the work of Williams and his associates in comparing the pelvis of the negro with that of the white, by the studies of Emmons and De Souza also by those of Acosta-Sison and Calderon. The present study also shows less marked but none the less definite, indications of national as well as racial pelvic differences which are apparent even on external examination of the living subject. It is of course, obvious that much more accurate deductions could be drawn by more complete and extensive pelvic measurements. The author regrets that he has been unable to make these comparisons, but the conditions under which the work was done made it none too easy to secure even the measurements which were obtained."

Summary: "French and American pelves show the same general external form.

"The French pelves are in the main slightly smaller than the American. The average external measurements of the French are uniformly smaller than the American.

"The range of variations of external measurements is generally somewhat greater in the French than in the American.

"The standard deviation is about the same for the French and the American pelves, some measurements showing slightly more in the American, others a slightly greater deviation in the French.

"The coefficient of variability is quite low and is about the same for both groups.

"The correlation of the different measurements is definitely lower in the American than in the French pelves. The same measurements, however, show about the same order of correlation in both series, the lowest correlation being between the external conjugate and the interspinous, and the highest between the interspinous and the intercristal."

UNTERSUCHUNGEN ÜBER DIE TORSIO FEMORIS UND DAMIT IM ZUSAMMENHANG STEHENDE FRAGEN. By Altmann (F.)—*Z. Anat. & Entwicklungsgesch.*, 1924, LXXV, 82–126.

This valuable comparative-embryological paper on the ontogenic torsion of the femur, comprising careful studies on representatives of all vertebrates except (naturally) fishes, leads among other results to the important conclusion that in man (and perhaps also the anthropoids) alone can a true torsion in the femur be demonstrated. In a human embryo of 17 mm. greatest length the torsion amounts to —11°, this rises constantly to an average of +31° in fetuses of the last few months of pregnancy; during postnatal life this torsion decreases again to about +12° in adult whites. This human torsion is not conditioned by any mechanical factors existing in intrauterine life, but constitutes an inherited growth-tendency of the bone itself.

A. H. SCHULTZ.

ON THE HYPOTROCHANTERIC FOSSA AND ACCESSORY ADDUCTOR GROOVE OF THE PRIMATE FEMUR. By Appleton (A. B.)—*J. Anat.*, London, 1922, LVI, parts 3 and 4, 295–306.

In this paper attention is directed to the following points:

"The name *fossa hypotrochanterica* is conveniently reserved for a fossa, groove or pit at the side of the insertion of M. *gluteus maximus* on the femur.

"In addition to this depression there occurs another groove on the posterior aspect of the Primate femur, in the neighborhood of the lesser trochanter. It provides attachment for a specialised portion of the adductor musculature, and is given the name of "accessory adductor groove." With the specialization of *two* accessory adductor aponeuroses in certain Catarrhinae, two corresponding grooves make their appearance on the femur.

"Grooves are also present in many *Primates* at the sites of attachment of MM. *pectineus*, *addcutores longus* and brevis.

"All of the above mentioned fossae and grooves may be replaced by ridges; the frequency of which varies in different species.

"The femur of *Prosimiae* is widely separated from that of *Primates* by differences of markings and muscular attachments. It presents a closer approach to that of *Insectivora.*

"Among *Primates* the hypotrochanteric fossa presents considerable variety of situation; an extreme condition is presented by the large *Simiidae.*

"With the reduction of the accessory adductor musculature in Man, there is an absence of any special groove or ridge for its attachment.

"In man the hypotrochanteric fossa occupies a position approximating to that of the accessory adductor groove in other *Primates.*"

ON THE SESAMOIDS OF THE KNEE-JOINT. By Pearson (Karl) and Adelaide Davin—repr. fr. *Biometrika*, 1921, XIII; I—Man, 43 pp., 18 pl.; II—Evolution of the Sesamoids, pp. 44–96, 19 pl.

A high class anatomical and comparative piece of work on the subject, with very good illustrations. The authors show that no parts of the skeleton, however small they may be "are without exceeding interest if time can be devoted to their study." They reach few if any definite conclusions, but show many new facts, not a few of which are also of interest to anthropology. The work is a worthy sequence of that by Dr. Pearson and Julia Bell on "The Long Bones of the English Skeleton."

VARIATION IN THE SOFT PARTS: BLOOD

The Racial Distribution of Isohemagglutinin Groups. By Lewis (Julian H.) and Deborah L. Henderson—*J. Amer. Med. Assn.*, Oct. 1922, 1422–'4.

"According to our present understanding of human isohemagglutinins, there exist in the blood two types of specific agglutinating substances, which may be designated *a* and *b*. In the red cells there are two specific types of agglutininogenic substances which may be called *A* and *B*. The agglutinin of Type *a* will agglutinate only cell containing the agglutininogenic substance *A*, and agglutinin *b* will agglutinate only cells containing Agglutininogen *B*. Obviously, one type of agglutinin will occur only in the absence of its corresponding agglutininogen, a fact utilized in classifying samples of blood. A given specimen of blood may contain either one of these specific agglutinins, or both, or neither. This distribution of agglutinins and agglutininogens makes it possible to divide all samples of human blood into four different groups."

According to H. and L. Hirschfeld (*Lancet*, Oct. 18, 1919, 675) who "examined about 8,000 samples of blood from the various races assembled in Europe during the recent war, the distribution of the four groups of hemagglutinins among these people varied extremely, but certain races could be grouped together because of the similarity in the distribution among them of the specific agglutinins *a* and *b*. This grouping of races corresponded somewhat to the grouping made on an anthropologic basis; it corresponded still more completely to the geographic distribution of the races. It was found that the European type, including Englishmen, Frenchmen, Italians, Germans, Austrians, Bulgarians, Serbians and Greeks is characterised by the prevalence of Group II of the hemagglutinins and a low incidence of Group III. Among the Asio-African group, including Malagasies, Negroes, Anamese and Hindus, the incidence of Group II is low, while that of Group III is high. There is an intermediate type including Turks, Arabs, Russians and Jews, in which the two groups occur intermediate to that of the European and Asio-African types. The proportion of the prevalence of Agglutinin *a* and Agglutinin *b* in each race is expressed numerically as

Jansky Blood Grouping

Group	Effect of Serum on other Groups	Effect of Other Groups on Cells
I	Agglutinates cells of the three other groups; contains Agglutinins *a* and *b*	Inagglutinatable; contains no agglutininogen
II	Agglutinates cells of Groups III and IV; contains Agglutinin *b*	Agglutinated by serum of Groups I and III; contains Agglutininogen *A*
III	Agglutinates cells of Groups II and IV; contains Agglutinin *a*	Agglutinated by serum of Groups I and II; contains Agglutininogen *B*
IV	No agglutinative effect; contains no agglutinins.	Agglutinated by serum of Groups I, II and III; contains Agglutininogens *A* and *B*.

a biochemical race index. The race index for the European peoples varies between 4.5 and 2.5; for the Asio-African peoples it is 1 or less, while the intermediate type is characterized by a race index of from 1 to 2."

The present authors, who have examined the blood of 270 American Negroes, come to the following conclusions:

"The distribution of isohemagglutinin Groups II and III among American Negroes is very different from that among the white race.

"It approximates the distribution of hemagglutinin groups among African Negroes, but differs from the latter in an increase of the percentage of Group II and a decrease of the percentage of Group III.

"Since the difference in the distribution of hemagglutinin groups among African and American Negroes lies in the direction of an approach to the distribution among the white race, it is assumed that the change is due to intermixture with the latter."

THE BRAIN AND SPINAL CORD

GEHIRN UND RÜCKENMARK. By Villiger (Emil)—8–10 issue, 1922, 8°, 328 pp., 262 illustr's.

A standard German textbook on the brain and spinal cord. Part I is devoted to Morphology; Part II deals with the Nervous Fibres; and a very useful addition is Part III which shows successive brain sections, with explanatory text.

Three desiderata may be mentioned. First, more attention to variation; second, a comparative section; and third—mechanical--a more pleasing selection of pigments for the colored illustrations.

DAS MENSCHLICHE GEHIRN. By Pfeifer (R. A.)—4–8 issue, 1923, 8°, 157 pp., 111 figs.

This nice volume is in a measure a complement of the preceding (Villiger's), though a quite independent publication. It deals with: General topography and gross anatomy of the central nervous system; Histology of same; The construction-plan of the human brain, and the Mental functions; Examples of psychophysical analysis of the cerebral functions; The peripheral distribution of the nerves and the most important connecting tracts between the spinal cord and the brain; and Literature.

ON THE EFFECT OF CAPTIVITY OR DOMESTICATION ON THE BRAIN WEIGHT OF SOME MAMMALS. By Donaldson (Henry H.)—The Wistar Institute of Anatomy and Biology.

In the rat, the guinea-pig and the rabbit—all rodents—also in the lion and the fox, the brain weight (or cranial capacity) is less in the captives than in the wild. The deficiency in captive lions is 19 per cent (Hollister) and in the domesticated guinea-pigs about 7 per cent.

Mere captivity may produce a marked effect on animals caged when young. Studies on the rat show that the olfactory bulbs are specially responsive to changed conditions. A defective diet retards their growth. The growth of the brain and bulbs is stimulated by exercise. In the rat the lower weight is not due to a loss of neurons, but to a reduction in their size (Holt, Sugita). This reduction appears to involve the cytoplasm of the neurons more than the myelin, as indicated by the change in the percentage of water. Captivity has apparently a greater effect in the cases where the departure from wild habits and diet is more marked. The mechanism of this retardation in growth is undetermined.

H. H. D.

Studien zum Domestikationsproblem; Untersuchungen am Hirn. By Klatt (Berthold)—Leipzig, 1921, G. Borntraeger ($3.60). 8°, *Bibl. Genet.*, II, 180 pp., 2 tables.

A contribution of much value on the difficult subject in question. It deals with: Generalities; Measurements; Morphology; and Theoretical Considerations. More in detail, the author considers the Significance of Sex, Age and Race; Significance of Size; Cranial capacity; Brain weight; Weight of separate parts of the brain; Individual variation; Surface morphology of the brain; Difference between wild and domestic forms; and Relation of the results to anthropology and heredity besides others of less concern. The bulk of the work has naturally been done on the brains of animals, particularly the *canidae*. For the many interesting results (which regrettably are not summarized) the reader must be referred to the original. The section on "Domestikationsergebnisse und Anthropologie" is somewhat disappointing, being essentially theoretial discussion. The book is supplemented by a rich bibliography.

Origin and Evolution of the Cerebellum. By Herrick (C. Judson)—*Arch. Neurol. & Psych.*, 1924, XI, 621–652.

The functional factors which have probably operated in the differentiation of the cerebellum are reviewed comparatively and embryologically. The isthmus is a region of retarded differentiation in the neural tube, for here no important cranial nerve roots have their nuclei. Accordingly, this region is not under the dominant physiologic influence of any single functional system of peripheral nerves and this is a favorable locus for the elaboration of a higher center of coordination of all bodily movements of proprioceptive type. Into this region of lower vertebrates there is a forward extension of the primary bulbar centers of the vestibular and lateral line nerves and a backward extension from the midbrain roof of correlation tissue of optic, somesthetic and tactile systems, to which a spino-cerebellar system is added. The conjunction of these two areas of differentiation, from opposite sides of the lateral recess of the fourth ventricle, forms the definitive cerebellum. The steps in this history are summarized and the influence of these functional factors is noted in the differentiated cerebella of representative vertebrates. In mammals an additional functional factor is introduced—the cortico-ponto-cerebellar connections and the correlated elaboration of the cerebellar hemispheres. The paper closes with some reflections upon the probable method of function of the human cerebellum.

C. J. H.

Studi sul midollo spinale dello Cimpanzè. III. Un nuovo indice volumetrico; Revisione del volume dei segmenti midollari. By Sergi (Sergio)—*Riv. Antropol.*, Rome, 1922, XXV, (repr. 20 pp , 8 diagr.).

In this additional contribution to the subject the author shows that the relative volume of the grey substance as compared with the whole mass of the spinal cord in the chimpanzee that was studied, was greater than it is in man in the cervical and sacral, but smaller in the thoracic and lumbar regions. Prof. Sergi also found a remarkable development in the thoracic region of the chimpanzee of the white substance. Finally, the spinal medulla in this chimpanzee was better developed on the left than on the right side.

Doubling of the Spinal Cord. By Lipshutz (B.)—*Arch. Neur. & Psych.*, 1920, IV, 16–23.

"Variations in the gross anatomy of the spinal cord are unusual. Observation of many spinal cords in our regular class dissections during a period of five years, tends to confirm this statement. During this period one double spinal cord was found. . . The specimen was obtained from an adult white male cadaver, well nourished, about 35 years of age and of unusually good physique. A careful external examination showed no abnormalities. The vertebrae were normal and there were no abnormalities of the bony canal, either ventral or dorsal to the spinal cord. The skin and overlying tissues of the lumbar and cervical region were likewise without abnormalities. . . The spinal cord was divided in its caudal portion into two distinct symmetrical halves. . . The bifurcation began at the caudal border of the eleventh thoracic vertebra and extended to the caudal limit of the cord forming two independent symmetrical halves. The caudal limit of each half was at the level of the cephalic border of the first sacral vertebra."

Über die Kerne der Raphe und der benachbarten Anteile der retikulierten Substanz. I Teil: Säugetiere. By Pekelsky (Anton)—*Arbeiten Neurol. Inst. Wiener Univ.*, XXIII, No. 3. Repr. Leipzig and Vienna, 1922, 73 pp., 8 figs. in text.

An exemplary piece of comparative study on certain histological elements (the nuclei of the raphe and neighboring reticulated substance) of the brain which appear to be of considerable importance. Extends to the brains of man, the anthropoid apes and all the familiar lower mammals.

ORGANS OF SPECIAL SENSE

The Anatomy of the Human Eye and Orbit. By Goldnamer (William W.)—8°, Chicago, 1923, 224 pp. (The Professional Press).

The object of the author in preparing this well-printed and illustrated volume was to make "these pages a useful summary of vitally interesting information for those who wish to attain a practical knowledge of the subject."

The parts of more direct interest to Physical Anthropology are: Chapter VII, which deals with measurements of the orbit; and Chapters XIV and XV, treating of Anomalies and giving tables of measurements.

Forty-one skulls of various races were utilized, and the measurements taken on each orbit numbered no less than 24; however, with the exception of the standard height and breadth these measurements however valuable for the author's purposes have but little significance for general anthropometry. The tables at the end of the book give dimensions of the eye itself and of its various parts by different authors, and constitute a welcome gathering of data that would otherwise be difficult to find. Under "Anomalies" various interesting conditions are discussed, including the epicanthus and abnormalities of pigmentation; regrettably the discussions are too brief. It would be highly desirable to subject these matters also to a really exhaustive study.

DURA VOLUME IN THE MALE WHITE SKULL. By Todd (T. Wingate)—*Anat. Rec.*, 1923, XXVI, No. 4, 263–273.

"Whereas in my earlier work, based upon a much smaller number of specimens, I gave a tentative average of dura volume for the general population as about 50 cc., I am now able to qualify that average, for in male whites the mean dura volume is about 55 cc., or 3.66 per cent of the total cranial contents.

"Dura volume has a relatively high degree of variability; it is more than three times as variable as standing height and more than twice as variable as internal nasal length. Even compared with other constituent parts of the head, therefore, dura volume is variable. To what extent this variability is due to chronic disease is not evident, for it is very difficult to determine without doubt the ear-marks of an old and long quiescent pachymeningitis, and no clear separation of the chronically diseased specimens can be made in a series upon the basis of volume alone. Further, the variability of dura volume, though considerable, is not strikingly high for the head region.

"There is small but probably definite relationship of dura volume to age and to size of cranium."

THE THICKNESS OF THE SCALP. By Todd (T. Wingate) and Wilhelmine Kuenzel—*J. Anat.*, 1924, LVIII, Part 3, 231–249.

"We have described a form of head-spanner for obtaining auricular height upon the cadaver and in the living. The instrumental error of this apparatus, as checked against the Reserve craniostat, is 0.3 mm. The instrumental errors have been reviewed for the several instruments necessary to measurement of greatest length and greatest breadth upon the head and upon the skull. The relative accuracy of various instrumental methods of obtaining auricular height are shown in detail.

"Although full presentation of the thesis must be postponed, it is indicated that the subcutaneous tissues of the cadaver do not accurately represent the condition of the soft tissues during life. The average difference in auricular height between the cadaver fresh and embalmed is 2.6 mm. Consideration of the variabilities of length and breadth suggests that the probable true difference in each of these dimensions is 5.2 mm. This amount should be added to the dimension in the fresh cadaver in order to obtain the approximate breadth in life but for reasons stated in the text 7.8 mm. should be added to length to obtain the real living value.

"The average thickness of the soft tissues of the scalp has been ascertained for small samples of a general population and for male whites alone. For male whites these averages are: height (vertex) 5.8 mm., length (glabello-opisthion) 5.1 mm., breadth (Euryon) 7.0 mm.

"Shrinkage of the skull in drying having already been ascertained, it is possible, from the measurements on the dried skull, to compute the probable dimensions of the head in the fresh cadaver or in the living. The accuracy for a small sample of male whites is within 0.9 mm. of the directly ascertained average for each dimension.

"For individuals the deviation is naturally greater, but the average accuracy is within 6.6 mm. of the total of the three dimensions as directly determined. This has been shown to correspond to an accuracy in cranial capacity of within 50 cc.

"From the magnitude of the variabilities in thickness of the scalp it is desirable, in the calculation of cranialcapacity from head dimensions, to use a formula in which the diametral errors of opposite sign will tend to eliminate each other. It is probable that ultimately least square formulae will give better results than regression formulae because the former tend to diminish differences in the comparative value of the several diameters. It is not possible at the present time to devise such formulae since we have not yet clearly differentiated the various types of skull upon a basis of the relation of capacity to diameters. When this shall have been done and the appropriate least square formula can be applied, there is reasonable probability that we may hope for an average individual error of not more than 50 c.c."

ZUR BEURTEILUNG DER PLASTISCHEN REKONSTRUKTIONSMETHODE DER PHYSIOGNOMIE AUF DEM SCHÄDEL. By Stadtmüller (F.)—*Z. Morphol. & Anthrop.*, 1922, XXII, 337–372.

This paper is of interest chiefly for its historic review of the various attempts at reconstructing the physiognomy from the skull, for a new list of individual and average thicknesses of the soft parts overlying the facial bones, and for its bibliography of 82 references. The author describes and pictures his fifteen reconstructions of the face over skulls of various races and considers such attempts as fairly reliable for "race-portraits," but as insufficient in regard to details.

A. H. SCHULTZ

AN ANALYTIC STUDY OF NASAL FORM. By Pitkin (Carlos E.)—*Annals Otol., Rhinol. & Laryngol.*, Sept. 1924.

"Previous investigations upon nasal form have embodied mainly the following up of clues derived from observation of individual specimens.

The time is ripe for an investigation based rather upon samples of population. By this method individual differences find their appropriate place and do not preoccupy the mind. Statistical theory is involved in such a mode of attack.

"Upon the average, a nose which lies more under the cranium than in front of it shows a greater tendency to disharmony of nasal form, one of the indications of which is a deflected septum. Individual variation in nasal form is somewhat greater than cranial variation and much greater than bodily variation as a whole. We gather that mutual compensations occur in the form of constituent parts of any portion of the body and for the nose these compensations must be sought either within the nose itself or in neighboring parts of the skull. From a study of the general relations of the nose, it appears that an internal nasal compensation can be discerned in the relation of nasal floor to cerebral base line. It seems, further, that in a series of noses shown to be abnormal by the presence of septal deflection, this compensation is rather exaggerated, and the exaggeration may itself in part be the cause of the abnormal condition.

"External compensation is also found in the relations of nasal and posterior components of cranial length. The effect of failure in this external compensation would appear to influence largely the size of the nasopharynx. The external nose—that is, the part projecting upon the face—has a variability largely independent of cranial factors. The internal nose, that buried within the face, on the contrary, is greatly influenced by cranial form. There is some evidence that unnatural cramping occurs in certain noses in which deflected septum is a feature. And it is plain that the focus of disharmony is to be found in the area near the incisive foramen.

"Even the preliminary results already obtained give reasonable expectation that this method of study will eventually greatly enlarge our proper understanding of the factors which influence nasal form and bring about the successive characteristics of nasal growth."

HAIR

FACIAL HAIR BY RACE, SEX AND AGE. By Trotter (Mildred)—*Wash. Univ. Studies*, 1922, IX, 273–289 (Sc. Ser. No. 2).

The author's conclusions are that: "No sexual differences and no racial differences in the actual number of facial hairs have been found. The facial hairiness of man does not lend itself to the classification proposed by Friedenthal. There is no sexual difference in length or in diameter of facial hairs until after the tenth year. After the tenth year the length of the facial hairs in the male greatly exceeds the length of the facial hairs in the female. The facial hairs of women of the white race slightly exceed those of the colored race in length. After the tenth year the diameter of the facial hair in the male greatly exceeds the diameter of the hair in the female, but the smaller hairs in comparable regions of the face in the two sexes are similar throughout life. The hairs of the white race show a greater average thickness than the hairs of the colored race. In both sexes of both races the upper lip is the region showing the most constant tendency for vigorous growth of hair. There is no constant difference in length or in diameter of hairs of dark-haired women and light-haired women, but dark-haired women often seem to have a heavier growth of facial hair, chiefly because of deeper pigmentation."

On the Hair Slope in the Frontal Region of Man. By Bolk (L.)—*J. Anat.*, 1924, LVIII, Part 3, 206–221. repr. 8°, Cambridge (England).

"The material employed for this investigation consisted of foetuses chiefly from Dutch mothers, only eight being derived from the population of Java. . .The study of the hair streams on the human forehead does not lead to the results one would have expected. The variability in the structure of the hair pattern is so great in this region of the skin that one scarcely comes across two individuals who are entirely the image one of the other. Now one would expect that a study of this excessive variability would lead to a solution of the causes determining the hair slope, but this is in no wise the case.

"The only conclusion which could perhaps with some justice be drawn from a comparison of the different conditions, is that the hair slope is not determined by external influences but that it is probably the impression of certain conditions of growth in the skin. We are still, however, entirely in the dark as to the actual connection between the process of skin-growth and the hair slope."

The author also "had the good fortune to be able to examine the structure of the hair pattern of two dicephalic monsters. The result was rather surprising, for while on both heads of one dicephalus he found an entirely identical hair pattern, there were considerable differences in the two heads of the second monster."

Ueber den Haarstrich eineiiger Zwillinge. By Ludwig (E.)—*Anatom. Anz.*, 1922, LV, 1–11.

In this study on the direction and distribution of hair on one pair of human monozygotic twin fetuses a high degree of resemblance is found but no absolute identity between the two specimens. The condition known as mirror-imaging occurred at only one place, a whorl near the base of the ear.

A. H. Schultz

A Study of Ringed Hair. By Cady (Lee D.) and Mildred Trotter—*Arch. Dermatol. & Syphilol.*, 1922, VI, 301–317 (repr. 19 pp.).

"The appearance of pili annulati is caused by gas-filled interstices in the cortex and medulla of the hair. The condition occurs in normally pigmented hair and in hair turned gray as a process of senescence. It is not due to a lack of pigment or to pigment atrophy. There is no evidence that the condition is caused by any known pathologic process. It may vary in the degree to which it affects an individual hair, and may vary widely in the number of hairs it affects in different persons. The condition is compatible with the normal growth of hair. It may be transmitted by heredity directly from one generation to the next."

The Resistance of Hair to Certain Supposed Growth Stimulants. By Trotter (Mildred)—*Arch. Dermatol. & Syphilol.*, Jan. 1923, VII, 93–98 (repr. 8 pp.).

"Observations on the rate of growth of hair in normal individuals are recorded. The rate of growth of hair is different in different regions and shows a positive correlation with the cross section area. No effect on the growth of hair from application of petroleum, from exposure to sunburn or from shaving could be found."

Ueber das Vorkommen von Haaren an überzähligen Brustwarzen. By Kajava (Y.)—*Anatom. Anz.*, 1922, LV, 323–333.

Among 345 cases of supernumerary nipples (hyperthelia completa and mammillaris) in men of over 15 years of age hair on these nipples was found in 42 instances. Usually there is only one hair, rarely three or more; these may measure up to 4 cm. in length. On the normal nipples of adults no hair has been found so far; its occurrence on supernumerary nipples represents, according to the author, a finding in an atavistic form of a still older atavism.

A. H. Schultz

MUSCLES

Anthropometry of the Muscles. In Polish, with a good French résumé. By Loth (E.)—*Arch. Nauk Anthropolog.*, Warsaw, 1922, I, No. 3, small 4to, 160 pp.

Doubtless the most important work on muscular variation and its significance that has so far been written. It is based on the dissection of 60 apes, among which 15 anthropoids, and on 200 human subjects (120 male, 80 female, Polish). The principal conclusions are that, each muscle from the point of view of phylogeny presents numerous primitive characteristics which can be explained by its genesis and by various progressive features which indicate coming changes. Careful examination of each muscle shows more or less of primitive characteristics, some of which are of great antiquity, preceding the existence of the Primates. Then there are other characteristics that are of more recent phylogenetic development, and still others that may be regarded as prospective. A comparison of these features in the Negro and White give marked and interesting differences which show the Negro to be more primitive. Progressive features are in some respects more frequent in the males than in the females, the latter in this as in other respects remaining more conservative.

There are many highly interesting details for which it will be necessary to consult the original; and there are numerous good illustrations.

The Peroneus Tertius Muscle in Gorillas. By Morton (Dudley J.)—*Anat. Rec.*, 1924, XXVII, No. 5, 323–328, 2 figs.

"The gorilla is not an arboreal animal as were its ancestors, but an habitual ground dweller, and although its posture is characteristically semi-erect and its gait not completely bipedal, nevertheless the feet are distinctly plantigrade and bear a greater share of body weight than do the hind feet of digitigrade quadrupeds."

Beiträge zur Anatomie der Chinesen. Die Statistik der Muskelvarietäten. By Nakano (Tōtarō)—*Fol. Anat. Japon.*, 1923, I, 273–282.

Report on the variation in M. pyramidalis, palmaris longus, psoas minor, gemellus, sternalis, plantaris, peroneus tertius, and biceps brachii, in the Chinese, with comparative data on the Japanese, whites and negroes. The Chinese and Japanese, while differing somewhat in these respects, nevertheless are closer together than either is to the other two races. The pyramidalis, palmaris longus and gemellus, which in general are present in the Chinese, are absent in a small proportion of the Japanese, in a decidely larger proportion of the negroes and a still larger proportion of the whites; a similar relation, though the muscle was much more frequently present, was observed with the psoas; with the sternalis conditions are exactly reversed; while in the case of the plantaris, peroneus and biceps conditions are rather irregular. The writer reaches the conclusion that while marked variations exist, no race stands phylogenetically lower or higher in all the features considered in the paper.

Anatomische Untersuchungen über die Muskulatur eines neugeborenen Chinesenkindes. Ein Beitrag zur Anatomie der Gelben Rasse. By Kurz.—*Z. Anat. & Entwicklungsgesch.*, 1922, LXIV, 476–532.

A careful, very detailed description of all the muscles in a newborn Chinese girl. In a considerable number of instances these muscles differ more or less from their normal condition in whites.

A. H. S.

Die Haut und Skelettmuskulatur des Kamerunnegers Samuel Jakob. By Lanz (T. von)—*Z. Morphol. & Anthrop.*, 1922, XXII, 373–434.

In this paper the muscles of one negro (m., 49 y., Cameroon) are recorded. As in most previous descriptions of negro musculature, it is found that there are many well defined points of distinction between the muscles of negroes and those of whites, the former showing a generally more primitive organization.

A. H. S.

GENITAL ORGANS

Ueber den Bau des Urogenitalapparates bei den männlichen Primaten. By Mijsberg (W. A.)—*Verh. Kon. Ak. Wetenschap.*, Amsterdam, Sec. 2, XXIII, No. 1. Repr., 8°, Amsterdam, 1923, 92 pp.

A valuable piece of work, leading the author to the following conclusions (among others): The platyrrhine and anthropoid apes show alternative conditions, leading on one hand in the direction of man, on the other in that of the Cercopithecidae. In general however they occupy an intermediate position. Among the anthropoids the most distinctive form is the orang which varies now in the direction of man and now attaches itself to the Cercopithecidae. The Siamang is in some respects more primitive than the rest of the anthropoids. There is an exhaustive bibliography.

THE EXTREMITIES

Evolution of the Longitudinal Arch of the Human Foot. By Morton (Dudley J.)—*J. Bone & Joint Surgery*, Jan. 1924, VI, No. 1, 56–90.

"Comparative analysis of the human, anthropoid and other primate feet clearly indicate that the foot of man was evolved from a grasping, arboreal type such as is peculiar to the modern great apes. Furthermore the great ape or gorilloid type of foot presents an intermediate stage in structural and functional modification through which, *of necessity*, the evolutionary development of the human foot had to pass.

"The results of this analysis conform with other extensive evidence pointing out the close relationship of man and the great ape group, and make more convincing the correctness of Darwin's conclusion in placing man's origin in the ancestral great ape stem.

"The erect posture is an extremely ancient character, developed by arboreal life, and it had been fully acquired by the ancient anthropoid group as its natural arboreal posture earlier than the time of the separation of the human offshoot. The erect posture was retained by the early human representative as the *position of choice* from the very beginning of his terrestrial life, because the previous arboreal use of it had become firmly established by structural adaptations and modifications of his nervous system.

"The human foot is a specialized organ for leverage in bi-pedal locomotion. Its characteristic longitudinal arch conforms in its external contour and in its trabecular architecture to the direction of the movements of force in such leverage action, thereby demonstrating the process by which its form was evolved. The elevation of the arch was greatly aided by the bowstring action of the flexor muscles against the sustentaculum tali, in raising the inner side of the os calcis.

"The longitudinal arch is absolutely not a modification of the previous supinated posture of the arboreal foot, for had that posture been retained the outer border of the foot would have become hypertrophied as the weight-bearing portion, and the inner border would have become atrophied because it had been held in an unusable position.

"The position of the line of leverage between the first and second metatarsal bones in the human foot is a distinct heritage from a previous grasping arboreal foot in which the movement of body-weight advanced between the two grasping portions, hallucial and outer digital. By such a previous grasping development the greater amount of function in weight-bearing was concentrated along the inner border of the foot and established conditions that were essential to the modification of this part to form the anterior pillar to the ultimate human arch.

"The posterior pillar is the result of adaptation and hypertrophy of the os calcis for weight-bearing in association with the erect posture. It was entirely a terrestrial development.

"Fixed adduction of the hallux in the developing human foot was acquired as lifting of the sustentaculum tali changed the abruptly inwardly inclined plane of the calcaneal facets (that characterizes the arboreal foot) to a plane which was more level and sloped more directly forward. The change in the position of the os calcis brought about the characteristic "balance" of the human foot and obviated the necessity of abduction of the hallux for inward lateral stability.

"The position of the center of body pressure as it enters the human foot is not so important to foot balance as the degree of inward slope of the calcaneal facets which support the astragalus. The inward thrust of body-weight to overthrow the foot's normal balance is rapidly magnified with each degree of increased inward inclination of the plane of these facets.

"Pronation as a static disorder of the modern human foot, presents its particular danger in that the associated increased inward slope of the calcaneal facets cannot be counteracted upon by a divergence of the hallux as in the earlier developmental stages of the foot, because of the present fixed adduction of that member, and the added restricting action of shoes. Consequently, pronation creates a progressive vicious circle by which inward gravitation of body-weight depresses the inner border of the facets, which in turn, by increased inclination magnifies the inward lateral thrust."

THE STATICS OF THE HUMAN ARCH WHEN SUBJECTED TO BODY WEIGHT. By Dunn (Halbert L.)—*The Military Surgeon*, June, 1923. Repr., 8°, 64 pp.

The data obtained are based on the study of the feet of 108 males and one female. The males were college students and soldiers. The results of careful measurements and observations are principally as follows:

"The medial longitudinal arch of the human foot acts mechanically like a true arch in the distribution of additional loads to which it is subjected. Both the high and the low arch can be functionally normal. The reaction of an arch to static forces depends almost entirely upon the integrity of the ligaments by which it is supported. The best criteria of normal and abnormal arches are functional tests."

The monograph is supplemented by a useful bibliography and by detailed measurements.

A Comparative Study of the Foot and Tread Index. By Harrower (Gordon)—*J. Anat.*, 1924, LVIII, Part 4, 285–298.

"In the East, where the greater portion of the population are barefoot, opportunities for observing the different types of feet are more numerous than in the West." The writer's studies extended mainly to the natives of India. The main results were: In 71.9 per cent of 32 newborn babies of mixed native parentage the second toe was the longest. Among adults (Tamils, Malays, Sikhs, Hindus and Europeans) in 375 feet the second toe was longer than the great toe in 49.8 per cent. In only one case (a male Tamil) was the third toe the longest. In the Primates, excepting man, the third toe is the longest. The greatest degree of dominance (not merely in length) of the first toe is probably found in the Europeans. The little toe is undergoing reduction even in peoples who go barefoot. The "tread index" of the foot was found lowest in the Tamils, highest in the Chinese. The outline of the foot is "considerably modified in the booted races." Foot deformities are comparatively rare among the native population of Singapore.

Contribution to the Knowledge of the Epidermic Ridges on the Human Palm and of the Regularity of Their Occurrence and Heredity. In Czech, with good English abstract. By Vašílk (J. A.)—*Antropologie*, (Prague), 1924, 17–39.

In the statistical part of this work the author shows his material divided into formulae. Five of these, which Schlaginhaufen thought common to all human races, are with some others also common to both sexes among the Czechs.

It is well known that the right hand has generally a higher formula, showing the more adapted type. Table 3 illustrates that the maximum of male formulae begins with D 11, of female ones with D 9, showing more adaptive types on man's and conservative ones on woman's hand. The thenar pattern has only a few sexual differences.

Cases in the material were observed where epidermic ridges were transformed into warts and rings, and also into dams the direction of which can be parallel to or intersecting the direction of the ridges. The author cannot say whether these cases called "Interruption of epidermic ridges" are atavisms or persisting embryonal conditions.

In the genetic part the author shows the heredity of whole formulae and also of single lines. Also the figurae tactiles and triradii accessorii in interdigital areas were transmitted. In Table 9 is shown a recessive heredity of the thenar pattern. As the figures of interdigital areas and the thenar pattern, so the hypothenar patterns may be transmitted from the parents' left to the filial right hand and *vice versa*. The "Interruption of epidermic ridges" is transmitted, and that at similar places (thenar, hypothenar, etc.) as in the paternal generation. The interruption, however, is generally not transmitted if it was only on one hand of one of the parents.

Weitere Untersuchungen über die Scapula, speziell über die Scapula scaphoides. By Frey (H.)—*Z. Anat. & Entwicklungsgesch.*, 1924, LXXIV, 240–284.

For the second time the author has investigated the scapula, this time on a material consisting of 130 dissecting-room bodies, the occupation of each individual being known. After a thorough consideration of the literature she describes her own findings, which are particularly valuable since variations in bone and muscle could be studied together, and this on both halves of the body.

The height of the fossa infraspinata is directly dependent on function; it is greater in men than in women, in strong than in weak individuals, and on the right than on the left scapula. In individuals in professions which require little strength and no great excursion of the arm the fossa infraspinata is shorter than where a profession means the opposite. A further effect of function is found in the cristae musculares which converge toward the glenoid cavity on the infraspinous fossa. These crests represent ossified tendinous insertions of muscles, tend to strengthen the scapular plate and are particularly marked in strong individuals whereas they may be lacking completely in weak persons. The form of the vertebral border of the scapula is also closely correlated with function and hence with the height of the infraspinous fossa. In individuals with a professional occupation leading to but small movements in the upper limbs a convex border is predominating, whereas with the reversed conditions a straight or even concave border and high fossa are found in a large majority of the cases. Racial as well as sex differences in the form of the vertebral border are explained by the author as due merely to differences in function. Differentiations in the musculature are closely associated with and responsible for changes in the scapular form. The rhomboideus major muscle, for instance, often splits, sending a separate portion to the inferior angle of the shoulder blade. Furthermore, the same muscle in many cases does not insert along the entire vertebral margin but only on its more caudal portion. Both these conditions are new developments, only found in man, tending to transmit the muscle effect directly to the lowest scapular point thus creating favorable conditions of leverage. The author believes that up to 25 years of age the vertebral border of the scapula may change its form under the influence of function.

A. H. Schultz

De l'asymétrie du squelette des membres supérieurs By Mendes Corrêa (A. A.)—"*C. R.Acad. Sci.*, Paris," séance du 6 Fevrier, 1922, t. 174, p. 416.

The problem of anatomical 'dextrism' or 'sinistrism' of the upper limbs is not solved by such simple and general conclusions as some authors have enunciated. The author, in 463 bones from the shoulder, the arm and the fore-arm of Portuguese people, does not find, between the two sides of the body, differences with a distinct statistical value, unless it is in such elements as the index of the radial diaphysis, the collar-bone dimensions, and the breadth of the shoulder blade. He noted that, as a rule, the superiority of the right side over the left is more frequent, but the proportion of anatomical *gauchers* in the skeleton of the arm and fore-arm is far greater in his series than in the French series of Rollet.

M. C.

OSTEOMETRIA PORTUGUESA—IV—Esqueleto do braço e do antebraço I, 15. By Mendes Corrêa (A. A) Coimbra, 1923, 39 pp.

This is a continuation of former metrical studies by the author, on some scores of Portuguese skeletons of both sexes. He finds some important sexual differences in the vigour indices of the humerus and radius, the epichondylo-trochlean index, the index of the radial diaphysis, the radio-humeral index, the index of the cubital diaphysis, etc. The differences between the right side and the left are sensible only in a smaller number of metrical elements. From the most part of their characteristics the Portuguese stand by the side of the other European populations, only radii are relatively more incurved.

M. C.

DAS FORAMEN SUPRATROCHLEARE HUMERI. By Schinz (H. R.)—*Fortschr. Geb. Röntgenstrahlen*, 1922, XXIX, 193–200.

Of the conclusions in this paper may be mentioned: The foramen supratrochleare, a communication between the fossae coronoidea and olecrani in the humerus, has no atavistic significance. It has never been found before puberty, but is not of very rare occurrence in X-ray photographs of adults. If present, this foramen for the most part exists in both arms. It is correlated with a strong hyperextension of the forearm. In one instance the foramen was found bilaterally in mother and daughter which would seem to indicate that heredity influences this condition.

A. H. SCHULTZ

LENGTH OF LONG BONES AND THEIR PROPORTION TO BODY HEIGHT IN HINDUS. By Pan (N.)—*J. Anat.*, 1924, LVIII, Part 4, 274–378.

The observations extend to 142 adult subjects, 86 males, 56 females. The average proportions to body length are: Femur, 26.2 per cent; tibia 22.3 p. c.; humerus, 18.8 p. c.; radius, 15.1 p. c. The proportions were found to be alike in the two sexes.

UEBER UNVOLLSTÄNDIG ASSIMILIERTE LETZTE OCCIPITALWIRBEL BEIM MENSCHEN. By Bolk (L.)—*Anatom. Anz.*, 1922, LV, 156–162.

Two new variations in the manifestation of the occipital vertebra are described; these represent an incomplete assimilation of the latter vertebra. The first group consists of cases with a long slender process pointing from the anterior end of one condyle towards the opposite side. This process corresponds, in the author's opinion, to the hemal arch of the last vertebra which has become assimilated with the occipital bone; normally, only these arches were taken into the skull, while the body of the vertebra became reduced, being represented by the rare condylus tertius. The second group is composed of skulls with a free process running posteriorly from the condyles and representing the dorsal arches of the occipital vertebra.

A. H. Schultz

Die Gabelung der Halswirbeldornen und ihre Ursachen. By Eggeling (H. von)—*Anatom. Anz.*, 1922, LV, 33–94.

A bifurcation of the ends of the spinal processes of the second to the fifth or sixth cervical vertebra exists as a rule in whites and, although not as regularly, in some primitive races. Ontogenetically this bifurcation can be found rather early. Among apes and monkeys a double end of the spinal process almost never occurs; only the chimpanzee shows this condition normally and then only in the epistropheus. After a careful study of the cervical spine and muscles in representatives of all primates, the author concludes that this bifurcation in man is the result of the strengthening of the musculi semispinales cervicis and interspinales breves, which in itself is directly connected with the attainment of erect posture.

A. H. Schultz

BONES OF THE SKELETON

Differences in the Time of Development of Centers of Ossification in the Male and Female Skeleton. By Pryor (J. W.)—*Anat. Rec.*, 1923, XXV, No. 5, 257–273.

The bones of the female ossify in advance of the male. This is measured at first by days, then months, then years. "The above observation was made after a study of 554 roentgenograms of the hands of children from three months to fourteen years of age. Two hundred of these were under seven years of age. This conclusion was based on the time of development of centres of ossification in the bones of the carpus; in the epiphyses of the metacarpals, phalanges, the distal extremity of the radius and ulna and the time of union of the epiphyses with the shaft in older cases.

"Comparisons were made between brother and sister; twins of the same sex; twins of the opposite sex and the average of male and female hands of the same age. With these findings in view and the conclusions accurate, the first centres of ossification appearing in the embryo would be in the female. . .The conclusions in this paper are based upon the study of roentgenograms of 140 fetuses from ten and one-half weeks to thirty-eight weeks of age, of which seventy-one were male and sixty-nine were female; and one hundred newborn babes from a few hours to ten days of age, of which forty-eight were male and fifty-two were female. . .

"In the ossification of the human skeleton the female is in advance of the male from the earliest developments of centres of ossification in the embryo and throughout intra-uterine life, progressing from days to weeks and months. After birth the differences are progressive up to the union of epiphyses with the shaft of the long bones which takes place with the female from 3 to 4 years in advance of the male."

METHODS

ANTHROPOMETRIE UND MEDIZIN. By Scheidt (Walter)—*München. med. Wchnschr.* 1921, No. 51. (repr. 4 pp.)

A well written small paper which considers critically the present-day relations of some medical authorities to Anthropology and Anthropometry.

CONTRIBUTIONS TO THE SOMATOMETRIC CHARACTERIZATION OF THE INDIVIDUAL. By Scheidt (Walter)—*Z. f. Konstitutionslehre*, 1921, VIII, No. 3, 259–268.

The article deals especially with an important method of determination of the weight-relations "Schwerpunktschöhenbestimmungen."

LEITLINIEN ZUR BEOBACHTUNG DER SOMATISCHEN MERKMALE DES KOPFES UND GESICHTES AM MENSCHEN. By Weninger (Josef)—*Mitt. Anthropol. Ges. Wien*, 1924 LIV, 232–270, 17 figs. in text, 1 pl.

Useful directions for classification and recording of descriptive characteristics of the head and façe. The author is apparently not aware that much the same system has been developed (and used for many years) in the United States by Hrdlička (see his "Anthropometry," 8°, Wistar Inst., Phila., 1920; also *Bull.* 62, Bur. Am. Ethnol., 1916) and by Hooton (see his recent writings).

MASS UND ZAHL IM BEREICHE DER LEBENSERSCHEINUNGEN. By Witzig (J.)—*Fr. Manns Pädag. Magazin*, H. 936, small 8°, 1924, 118 pp.

The object of this publication is a brief description of mathematical methods for use in connection with anthropometry and biometry. It is based on the methods of Fechner, Lipps and Bruns and is especially intended for the non-mathematicians. It utilizes considerable anthropological material (furnished by Prof. Schlagenhaufen). It is written clearly and will be found useful. The parts concerning the graphic method are however insufficient.

STATISTICAL METHOD. By Kelley (Truman L.)—New York, 1923 (The Macmillan Company 'Text Book Series'), xi + 390 pp.

"This book has been written with a view to serving two needs: that of biologists, economists, educators and psychologists who know little of higher mathematics, possibly care less, and who use statistical methods merely as a device to portray the facts of their group investigations; and that of those in the same fields who resort to mathematics to aid in the discovery of new truths." It deals with: The Tabulation and Plotting of Series; Graphic Methods; The Measurement of Central Tendencies; Measures of Dispersion; The Normal Probability Distribution; Comparable Measures; The Fitting of Curves to Distributions; Measures of Relationship; Functions Involving Correlated Measures; Further Methods of Measuring Relationship; Multiple Correlation; Statistical Treatment of Sundry Special Problems; and Index Numbers. In an

Appendix are added a List of Important Symbols, Bibliography, and Kelley-Wood Table of the Normal Probability Integral, together with Index and Alignment Chart. Anthropometry receives only indirect attention.

Preparation and Preservation of Anatomical and Embryological Material in the Field. By Schultz (Adolph H.)—*J. Mammal.*, 1924, V, No. 1, 16–24.

Useful practical directions for both biologists and anthropologists which will substantially aid in the gathering and saving of much valuable research material.

Daktylosophy. By Windt-Kodicek—8°, Wien, 1923. 125 pp., numer. illstr's.

The comprehensive and well illustrated volume deals with the significance and methods of finger printing and with the analysis and classification of the results. It is a well-written work, of close interest to anthropometry.

Classification and Identification of Handwriting. By Lee (C. D.) and R. A. Abbey—8° (D. Appleton & Co.) N. Y., $2.50, 113 pp. 36 figs.

"That in everyone's handwriting certain definite and fixed characteristics exist which serve to establish the writer's identity has long been recognized, but to date nothing has been published in this country on the subject of their classification." "A great amount of research work covering thousands of signatures was found necessary in perfecting the present system. . . No system will ever supplant fingerprints for the purpose of direct personal identification. . . Infallibility for any system of handwriting classification can never be attained; but society will be rendered a real service if the present system succeeds in bringing to justice an occasional transgressor of its laws."

The main object of this interesting little book is the identification of criminals, but doubtless there are in this system wider possibilities that are also of some anthropological interest (medico-legal, identification of definite persons in any walk of life). The several chapters deal respectively with: The Material; Fundamentals of the System; Classification; Indexing and Filing and Identification. To which is added a bibliography. The subject connects with Anthropometry.

Weight in Relation to Height, Age and Physical Type.—A Measuring Scale Prepared by the Division of Physical Education of the Board of Public Education, Philadelphia, Pa. (Price $1.00 on heavy linen paper. Publ. by the Board of Public Education). The physical education teachers in the Philadelphia schools had for many years expressed the wish to have a chart that at a glance would show if a child is of normal weight and height for his type, and the chart is an answer to that demand. It is based on Dr. Bird T. Baldwin's physical measurements of children. The chart can be used for measuring pupils from 40 up to 74 inches. Data relating to boys is printed in black ink and to girls in red ink. (The chart may be obtained from the Director of Physical Education, 17th and Pine Streets, Philadelphia, postpaid, at the price stated above).

A SIMPLE TRACING APPARATUS FOR MAKING TOPOGRAPHIC RECONSTRUCTIONS. By Scammon (Richard E.)—*Anat. Rec.*, 1921, XXI, No. 1, 19–24.

An apparatus of the diagraph type (Wash., Matthews, Martin) consisting of a tracing stand covered by a glass grating and an ingeniously constructed eye-piece. Though constructed primarily to assist in topographic reconstructions in studios of fetuses, the apparatus would doubtless prove of a wider application in anatomy and anthropology.

UNTERSUCHUNGEN UBER DIE MASSENPROPORTIONEN DES MENSCHLICHEN KÖRPERS. By Scheidt (W.)— *Zeitschr. f. Konstitutionsl.* 1921, VIII, 259–268.

The center of gravity of the human body is metrically determined by the following simple but exact method: The body lies on a horizontal board with the soles of the feet touching a small vertical board attached to the horizontal one at the place where the latter is hinged to a support. The head end of the horizontal board is supported by a wedge-shaped block standing on a scale; this wedge is to be placed so that its edge lies in a perpendicular plane touching the vertex of the head. The distance of the center of gravity from the soles (X) is now ascertained by the following formula:

$$X = \frac{A \times \text{Standing height of body}}{\text{Body weight}}$$

A stands for the weight in kilogramms read off the scale minus the weight necessary to balance the empty board.

This height of the center of gravity above the soles is expressed in percentage of the standing height. In 189 men between 20 and 47 years of age this index was found to vary between 54.0 and 66.3 with an average of 59.1. In 244 boys between 6 and 13 years the index average less, namely 56.5.

A. H. SCHULTZ.

TECHNIQUE D'IMPRESSION POUR L'ÉTUDE ANTHROPOLOGIQUE DES EMPREINTES PALMAIRES ET PLANTAIRES. By Stocks (E.)—*Rev. Anthrop.*, 1921, XXVI, Nos. 3–4, 82–88.

Author describes a new method of taking palmar and plantar reprints which gives much better results than the procedures now in use. He uses a wooden cylinder with paper placed over it. The blackened palm or sole is applied to the paper and by passing it over the rolling cylinder one obtains a complete impression.

DEMOGRAPHY

TUBERCULOSIS AMONG WHITE AND COLORED PERSONS (policy holders of the Company).—The death rate for tuberculosis (all forms) among white persons was under 100 per 100,000 (95.4), a decline of 1.8 per cent from the rate in 1921, and of 51.2 per cent from the 1911 death rate. During the year, however, the tuberculosis death rate of colored persons declined 9.2 per cent from the 1921 figure and 42 per cent from the 1911 rate. Much of the improvement in the tuberculosis death rate in the entire Industrial Department during 1922 arose, therefore, from the greater rate of fall of tuberculosis mortality among colored persons.

The other interesting items of the report are as follows: "The year 1922 recorded the lowest typhoid fever death rate in the history of the Company—(5.6 per 100,000) a reduction of one-sixth from the rate of 1921 and of nearly three-quarters from the rate in 1911. . . Three of the common communicable diseases of children (diptheria, scarlet fever, whooping cough) showed lower death rates during the year. . . A small decrease in the combined death rate for all puerperal diseases and condition was registered during 1922. . . The suicide and homicide records show slight improvement as compared with 1921. . . . An outbreak of influenza, with complicating pneumonias, was experienced during late January and in February and March of 1922. . . . The death rate for organic heart disease has been increasing since 1920. . . . The number of deaths from alcoholism increased from 122 in 1921 to 289 in 1922; the death rate rose from 0.9 per 100,000 to 2.1 which is equivalent to a rise of 133 per cent. This is the highest death rate recorded for alcoholism since 1917, but it is still much lower than the rates recorded in years prior to 1918. . . It should be understood that these figures do not include deaths from wood alcohol poisoning. . . The further rise in the automobile accident death rate is a challenge to the instinct of self-preservation of the American and Canadian populations. During 1922, the death rate increased 10.7 per cent over the 1921 figure. The 1922 death rate was nearly six times the rate for 1911. And 48 per cent of the deaths were of children under 15 years of age! . . . There was no important change in the cancer death rate during 1922. The rates for 1921 and 1922 are the highest on record for the twelve-year period 1911 to 1922. Considering the whole situation throughout this period of years, we find a *slight* underlying tendency toward increase in the death rate among insured wage-earners (.007 deaths per 100,000 per year) and a marked upward trend in the general population (.582 deaths per 100,000 per year).

Statis. Bull. Metrop. Life Ins. Co., January, 1923.

India Census of 1921 and Infuenza Epidemic of 1918–19. The London correspondent of the Journal of the American Medical Association, reporting recently on the fifth uniform census of India taken in 1921, states that the outstanding fact of the final report is the small increase shown in the population—1.2 per cent—in the decade elapsing since the next preceding census, which showed an increase of more than 7 per cent. Owing to the enormous task involved in compiling the data, the completed report for 1921 was not issued until this year.

The principal cause of the difference between the increases in population shown for the two intercensal periods is stated to be the influenza epidemic of 1918–19, which, in the course of a few months was known to have been responsible for 6,000,000 deaths in India. The census has established the fact that double the number—or 4 per cent of the vast population of that country—died during the epidemic. According to the 1921 census the population amounts to 319,000,000. The case mortality of the epidemic was placed at about 10 per cent, on which basis it is estimated that 125,000,000 people, or two-fifths of the whole population, were affected. The scourge is said to have come at a time when the economic power of the people had been greatly reduced by a successsion of bad seasons.

As regards the occupational distribution of the population, India is predominantly agricultural, no less than 73 per cent of the people being engaged in agricultural and pastoral pursuits. Industry supports about one-tenth of the population.

Some decline in the number of child marriages is shown. Forty years ago only 481 females per 10,000 between the ages of 10 and 15 years were unmarried, whereas the proportion shown in 1921 was 601. Between the ages of 5 and 10, the number of females increased during the same period from 874 to 907 per 10,000. (*Public Health Reports*, 1924, XXXI, No. 46, 2851–52.)

DECLINING DEATH RATE AMONG NEGROES. *Statist. Bull., Metrop. Life Ins. Co.*, April, 1922, 2–3.

A remarkable decline in the mortality of Negroes has taken place in the last decade. This decline can be traced to improvements in the death rates from tuberculosis, pneumonia, heart disease, Bright's disease, malaria, typhoid fever and pellagra. It is difficult to say just what forces have operated to bring about these changes; there are obviously many factors at work, including better hygienic as well as economic conditions. The improvement is not localized, but represents a phenomenon common to virtually all areas of the States.

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THE BIOGENETIC LAW AND THE SKULL FORM OF PRIMITIVE MAN

WILLIAM K. GREGORY

"The Phylogeny of Man from a New Angle" and "New Trends in Anthropology" are the titles of two papers dealing with the form of the forehead in primitive man and read by Charles Hill-Tout, the first before the Royal Society of Canada in 1921,[1] the second before the British Association meeting at Toronto in 1924.[2] Mr. Hill-Tout's methods and conclusions are summarized by himself as follows:

"The author aims to show in this paper that our earlier conceptions of the skull characters of primitive man were founded upon misleading data.

"That instead of instituting comparisons of human skulls with those of mature anthropoids, the comparison should be made with those of immature apes, which by the biogenetic law must represent more closely the ancestral type.

"He further points out that a comparison of the skulls of young apes with those of the young Neanderthal man, and both with those of modern children, reveals this ancestral type, and shows that when the problem is approached in this way the conclusion is forced upon us, contrary to what has been generally held, that the anthropoids and not man have departed most from the ancestral type in respect of skull characters, man himself having retained very closely the skull-form of the ancestor common to both branches of the Primates; and that in *Eoanthropus* we see that ancestral form best typified."

It is rather surprising to see these ideas claimed by their author as new. The occurrence of expanded foreheads in young stages of anthropoids and man led the late Professor Klaatsch to similar conclusions, while Dr. A. Smith Woodward in his description of *Eoanthropus*[3] has used the same facts to suggest that the retreating forehead and projecting brow ridges of the Neanderthal skull were degenerative gorilloid specializations which exclude those races from ancestry to *Homo sapiens*. Klaatsch[4] pictures the skulls of an infantile orang and chimpanzee in comparison with that of a human embryo in support of his argument that in the common ancestry of man and apes the skull was "finely rounded as it is in the young."

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[1] Trans. Roy. Soc. Canada, xv, Sec. 2, 47–82, figs. 1–8.
[2] Abstract published in J. Sci. Trans. B. A. A. S., Toronto, 1924, 65–66.
[3] Quart. J. Geol. Soc., 1913, lxix, 117, 151.

The reasoning of those who appeal to the "biogenetic law" for evidence as to the form of the forehead in the common ancestral stock of man and apes may be thrown into the form of a syllogism as follows:

1. The diversified descendants of a common ancestral stock in the course of ontogenetic development pass through structural stages which are reminiscent of the adult common ancestor.
2. Man and anthropoid apes, admittedly the diversified descendants of a common ancestral stock, pass through ontogenetic stages in which the forehead is steep and there are no supraorbital ridges.
3. Hence a steep forehead and the absence of supraorbital ridges were characteristics of the adult common ancestor of men and apes.

A doubt as to the universal validity of the biogenetic law or as to its applicability to the case in question seems never to have entered the minds of those who appeal to it in this instance. In other words their case rests upon a bold *petitio principii*. But if any ontogenetic stages are not reminiscent of the adult common ancestor, then any particular ontogenetic stage is open to the suspicion of not being reminiscent.

If the biogenetic law had the universal validity imputed to it by some earlier embryologists, it would be futile to compare all the adult skull forms of any diversified mammalian stock for the purpose of learning if possible from them alone which one or ones had retained most of the primitive adult characters of groups further down the ancestral tree. In other words, comparison of the data of the taxonomists and phylogenists on the one hand, with those of the students of adult morphology on the other, would be unnecessary and even misleading. If, for example, we were studying the different forms of the adult skull and dentition in the Viverridæ, it would be vain to conclude that *Viverra* rather than *Cryptoprocta* stood nearer to the ancestral skull type unless we happen to know that *Cryptoprocta* actually passed through a *Viverra*-like stage of development. Again, if the biogenetic law were infallible it would not be necessary to continue palæontological exploration in quest of successive stages in evolutionary history. If we wished to learn the form of the skull and of the jaws in the remote ancestors of the Canidæ, for instance, it would only be necessary to look at the bulging forehead and feeble jaws of the young animals. From such material we could easily infer that the adult ancestral dogs were very unlike the existing jackals, wolves and police dogs, which hitherto have been regarded generally as relatively primitive in skull form, and we should have to conclude that the Pekingese dog, with its bulging forehead and weak jaws, stands much nearer to the ancestral type. The series of the known fossil members of the dog family having more or less wolf-like skulls and coming from successive horizons of the Tertiary period, which have recently been very carefully studied by Dr. W. D. Matthew, and which he has shown gradually approach modern adult canine types as we follow them upward, would all have to be excluded from the line of ancestry of modern Canidæ and regarded as specialized degenerate forms which had fallen away from the large-brained standards set by their own puppies. By the same method we should learn that the modern breeds of short-faced, short-skulled pigs stand nearer to the ancestral forms than do the long-faced, long-skulled wild boars of present and past ages; that young kittens are far more primitive than the most ancient long-faced carnivores of the basal Eocene, which are ordinarily supposed to be extremely primitive in dental formula, dentition and skull form, but which fail entirely to conform to the doctrine that bulging foreheads alone are primitive.

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[4] The Evolution and Progress of Mankind (English translation), 1923, 98, 99.

But it may be replied that Klaatsch and Hill-Tout are not depending upon infantile stages alone. Hill-Tout in fact expressly uses the word "immature"; but if the biogenetic law can be shown to break down in the case of infantile characters resembling adult ancestral features, what guarantee have we that immature characters conform to the law? Many immature and young characters, such as the unduly long legs of colts, are obviously specialized, while others may be primitive. If the biogenetic law were universally valid it would seem legitimate to infer that the adult common ancestor of man and apes was a peculiar hermaphroditic animal, that it subsisted exclusively upon its mother's milk and that at an earlier phylogenetic period the adult ancestor was attached to its parent by an umbilical cord. The absurdity of this inference shows that the universal validity of the biogenetic law may not be taken for granted, and that in each instance the supposition that a given ontogenetic character is primitive requires independent evidence.

If the biogenetic law were without exceptions the marvellous processes of ontogenetic development would have only an historical or reminiscent aspect and not an anticipatory or adaptive one, since they would all be directed solely towards preserving a clear record of earlier adult stages rather than towards the production of viable animals. On the contrary it seems reasonable to interpret the acceleration of the development of the central nervous system and the consequent swelling of the forehead in fœtal stages of all vertebrates as so many necessary steps in preparation for the intricate reactions of breathing, feeding and maintaining the body in the optimum posture, which most newborn and young animals are called upon to perform. In other words, before Mr. Hill-Tout's conclusions could be accepted as reliable he would have to show that the swollen foreheads of immature apes and men have solely a reminiscent rather than an adaptive value. The neurologists, on the contrary, seem to be of the opinion that the large size of the brain in such instances is in preparation for the slow processes of building up one reaction after another and establishing more and more complex connections between the multitudinous centers.[5] Thus the bulging foreheads of the baby orangs figured by Hill-Tout in 1921, Figs. vi, vii, and by Klaatsch, may have the same highly adaptive value that they have in man.

If those who appeal to the biogenetic law are right, then we should also have to infer that the jaws in the adult common ancestors of apes and men were as feeble as they are in infantile and young stages of existing men and anthropoids. The extremely feeble condition of the jaws of infant stages is apparently related to the fact that in the young animals the jaws are used only for sucking and not for tearing tough food. Would Mr. Hill-Tout argue that the "common ancestor" lacked a third molar because that element is not found in place in immature jaws? May not the feebleness and the lack of bony ridges for the insertion of the jaw muscles in immature skulls be correlated with the feebleness of the jaws and the incomplete development of the dentition in those stages?

We do not have to rely, however, upon isolated items of evidence bearing upon this subject. There is in fact concurrent testimony from several independent sources. First let us consider the palæontological history of the primates in respect to the form of the skull and especially of the forehead and jaws. When we compare a modern human skull with that of the extinct genus *Notharctus*, we observe the following striking contrasts:

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[5] Tilney, F., and Riley, H. A. The Form and Function of the Central Nervous System. An Introduction to the Study of Nervous Diseases. 8°, New York, 1921.

Characters	Notharctus	Homo sapiens
Geological age	Middle Eocene	Pleistocene and recent
Braincase	Small, not expanded	Very large and expanded
Face	Expanded in front of braincase	Retracted beneath braincase
Forehead	Horizontal	Vertical
Facial axis	But slightly deflected upon basicranial axis	Sharply deflected
Premaxilla	Separated	Fused with maxilla
Dental formula	$I^2/_2$, $C^1/_1$, $P^4/_4$, $M^3/_3$	$I^2/_2$, $C^1/_1$, $P^2/_2$, $M^3/_3$
Mandible	Elongate, slender, with jaw not dissimilar to that of other Eocene mammals.	Short, deep, with protruding chin
Position of orbits	On opposite sides of the skull, near the middle, widely separated by muzzle	Wholly in front of braincase and near together
Olfactory chamber	Well developed	Reduced
Direction of orbital axis	Outward and forward	Forward
Bony septum behind orbits	Not developed	Developed
Supraorbital rims	Well developed	Confluent with and replaced by bulging forehead.

Thus it will be seen that the skull of *Notharctus* is vastly more like that of other primitive Eocene mammals than is the skull of *Homo sapiens*. *Notharctus* is also extremely primitive in its locomotor skeleton, in the anatomy of the middle ear, in the form of the brain, in the dental formula and in many other characters,[6] and in respect to the characters listed above, in the opinion of the present writer it is ideally primitive for later primates, including man.

But it may be objected that *Notharctus* is not in the direct line of human ascent and is in fact on the line of ascent either to the existing lemurs or to the South American monkeys. This, however, if granted in no wise militates against the fact that it is structurally intermediate between the skull of *Homo sapiens* on the one hand and that of the lower mammals, such as the Eocene insectivores and carnivores, on the other. Man is shown by his anatomical characters to be a highly specialized member of the order Primates, while *Notharctus* is shown by comparison with recent lemuroids, tarsioids, ceboids and cercopithecoids to be an extremely generalized type. Even the existing groups, taken as groups of lemurs, monkeys, etc., give us a series of stages, each beginning with a more *Notharctus*-like form and gradually approaching toward the higher primates. To suppose that the remote common ancestor of man and anthropoids had a vertical forehead without brow ridges is to invent an entirely hypothetical group and to disregard the series of existent intergrading conditions from that of the lower mammals on the one hand to that of man on the other.

Another concurrent line of testimony is supplied by the researches and conclusions of Elliot Smith and his colleagues on the evolution of the brain in primates. They point out that in primitive mammals generally the eyes are on the sides of the skull and are directed outward and forward, but that in man and the anthropoids the eyes are wholly in front of the brain and cranium and are capable of stereoscopic, bifocal vision, with biconjugate movements; also that between primitive mammals on the one hand and man on the other there is a well-graded series of intermediate forms, including lemuroids, tarsioids, ceboids, cercopithecoids and anthropoids. Their account of the evolution of the brain is entirely in accord with the series of skulls presented by recent and fossil primates, such primitive forms as *Notharctus* and *Adapis* having the eyes more nearly in the primitive mammalian condition.

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[6] 1919. On the Structure and Relations of *Notharctus*, an American Eocene Primate. Mem. Amer. Mus. Nat. Hist., N. S. v. III, Part II, Pls. 35, figs. 84, pp. 49–243.

From this point of view projecting brow ridges are a necessary consequence of the forward shifting of the orbits and are in fact merely a bony roof or expanded postorbital processes, existing before the balloon-like expansion and forward growth of the brain pushed the forehead into a vertical position above the orbits and so absorbed the primitive brow ridges.

The existence of an expanded vertical forehead in *Eoanthropus* and the "100-foot terrace men" throws little light upon the condition in the common ancestor of men and apes, for it should be realized that the differentiation of the Hominidæ occurred at a much earlier date than even the Lower Pleistocene, probably as far back as the Miocene, and that, as in many other cases, there may have been both progressive or accelerated branches with bulging foreheads, (*e. g.*, *Eoanthropus* and *Homo sapiens*) and primitive conservative forms with low foreheads and protruding brow ridges (*e. g.*, *Pithecanthropus*, Neanderthal, Rhodesian, Australian, etc.).

The researches of Gregory and Hellman on the dentition of primitive anthropoids and man afford strong evidence for the view that the adult common ancestor of man and the anthropoids was close to or identical with the genus *Dryopithecus* in respect to the form of the teeth and jaws; but this genus, like all other primitive anthropoids and men, had a massive mandible in the adult, implying the presence of projecting brow ridges and more or less retreating forehead, with well developed muscle areas. Obviously the male gorilla skull and all of the male anthropoid skulls are specialized in their several ways from the more primitive condition of *Dryopithecus*.

In brief, the evidence seems to support the conclusion that man, like all other primates, must have been derived from forms with a low forehead and moderately projecting brow ridges, like *Pithecanthropus*, and that bulging foreheads and reduced brow ridges, as in *Eoanthropus*, represent a modified condition.

THE TAUNGS APE

ALEŠ HRDLIČKA[1]

On February 7 of this year Dr. Raymond A. Dart, Professor of Anatomy University of the Witwatersrand, Johannesburg, South Africa, published in *Nature* a circumstantial, well-written account of the discovery, near Taungs, Bechuanaland, of a new fossil Primate, to which he gave the name of "*Australopithecus africanus*."

Such a find, so far south in Africa, was wholly unexpected and for that reason, coupled with Professor Dart's suggestion that the form might possibly be linked with the direct line of man's ancestry, aroused at once a widespread and keen scientific interest and discussion. As a result of this in a week's time (February 14) and again on April 18, June 13 and July 4, *Nature* brought a series of comments on the find by Keith, Elliot Smith, Smith Woodward, Duckworth, Broom and Sollas.[2] On February 14, there was also a note on the find by Keith in *The British Medical Journal*, and on April 20 the *Transactions of the Geological Society of South Africa* published a geological report on the site by Professor R. B. Young. Besides this the subject received much space in the South African as well as other journals; and finally an exhibit of the find, together with a pictorial attempt at reconstruction of the form, was prepared by Professor Dart for the British Empire Exhibition.

The gist of all these reports etc., is, that late in 1924, in a limestone quarry that for several years has been yielding petrified remains of various kinds and above all of baboons, there was discovered embedded in hard rock a skull of a much higher Primate. After being cleaned by Professor Dart, this specimen proved to be that of a young great ape of a hitherto unknown variety; and the skull and particularly the brain (solidified intracranial cast) seemed of such a form and differentiation that Dr. Dart conceived the possibility of its standing nearer than any other of the known great apes to the phylum from which man developed. This view, later supported by Broom and Sollas, was challenged by Keith, while Elliot Smith, Smith Woodward and Duckworth preserved a critical attitude, waiting for further information. The conflicting views of Dart and Keith are shown most recently in their two letters published in *Nature* of September 26. Dart's view is, in brief, that "the family typified by this form are the nearest to the prehuman ancestral type that we have;" while for Keith on the basis of the geological evidence "one can be certain that early and true forms of men were already in existence before the ape's skull described by Professor Dart was entombed in a cave at Taungs;" while on morphological grounds the "Australopithecus must be classified with the chimpanzee and gorilla."

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[1] Smithsonian-Buffalo Soc. of Nat. History Expedition, 1925.
[2] See bibliography at the end.

THE WRITER'S VISIT

The report of the find was received with a genuine though pleasurable surprise among students of the ancestry of Man and the Primates. This was soon followed by a live desire to learn more about the discovery; and it was the good fortune of the writer who was just about to start for the far southeast on a survey of everything in those parts of the earth relating to man's antiquity, that he was able to extend the journey to South Africa where both the specimen and the site could be examined.

His succeeding in this object was due in the largest measure to Professor Dart. Not only was it possible as a result of this to examine freely all the specimens discovered in the Taungs or rather Buxton quarry, but through the courtesy of the "Northern Lime Company," the owners of the quarry, a courtesy secured also through Dr. Dart, a fruitful visit of three days to the site itself could be realized.[3]

The gathered impressions and experiences are here given:

THE SITE

The Northern Lime Company quarry is located at a place known as Buxton, 9½ miles west of Taungs, a little station on the main railway line from Cape Town to the Belgian Congo. Taungs is in Bechuanaland, 731 miles north of Cape Town, 84 miles north of Kimberley. Buxton is a collection of works and houses belonging to the Company. The great limestone quarry is in the cliffs just to the west of the reducing works.

The main line of the railway runs through a shallow, broad and nearly flat erosion valley, running roughly from north to south. This valley, through parts of which runs the Harts river and which probably does not reach 500 feet at its greatest depth, is said to be about 18 miles wide at Taungs. It is bounded on both sides by a moderately high escarpment. On the west, opposite Taungs, this escarpment runs in a fairly straight line and rising to about 180 feet above Buxton, reaches the Kaap Plateau which extends northwesterly towards the Kalahari Desert.

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[3] Grateful acknowledgments for the courtesy and aid received on the site are due to Mr. A. F. Campbell, the Manager of the Company at Johannesburg; to Mr. A. E. Spiers, the Works Manager at the quarry, and to Mr. W. Rielly, the Mine Boss at the same place.

The cliffs in the vicinity of Buxton show horizontal layers of hard old ferruginous shales. A large depression in these shales, now opposite Buxton, became in times past filled by calcareous despoits which, on consolidation, formed a very hard and in many parts remarkably pure limestone[4] that for ten years has been intensively mined by the Northern Lime Company, with a very large supply still in sight.

The exposed parts of this limestone or, as Professor Young calls it,[5] calcareous tufa, became in the course of time pitted by many holes, crevices and caves; and some large caves as well as crevices and tunnels were also formed, probably by the action of water, in the interior of the mass. These internal cavities must have had external openings, for there is evidence that they were entered and perhaps inhabited by various animals which eventually left in them their skeletal remains.

Eventually, however, these cavities were all filled by washed-in and blown-in sand and earth, which in turn were permeated by water carrying lime in solution and these cemented the different materials, converting them from crumbly to very hard secondary rock. Thus the various cavities are now filled mostly with a hard sand-limestone which, due to the fine reddish Kalahari sand is more or less pinkish in shade and can thereby be recognized from the surrounding whiter stone of the older formation. A large and long irregular crevice-cave near the more central parts of what has been quarried was largely filled by more earthy material that became but partly indurated. A portion probably of the same cave remains in an open state with stalactites and stalagmites covering its ceiling and walls, while a much larger portion, left because of the non-paying contents, is completely filled with the crumbly darker material. All of this, as will be seen later, is of scientific importance.

After reaching Buxton and in company with the Works Manager, Mr. Spiers, a well trained man of much experience, the writer made a general survey of the quarry, of the rocky inclines above, and of the nearly dry ravine or gorge. On the second and third days these surroundings were revisited and the inspection was extended to the gorge of the Buxton River, from the springs above to the bridge just below Buxton, as well as to the low, extensive stone-covered swell on which are located the habitations of the white employés of the Company.

[4] Some notes on these deposits may be found in "The Limestone Resources of the Union," *Mem. Geol. Surv.* S. Africa, 2 vols, 8°, Pretoria, 1917; Buxton in II, 116, no illustr's.

[5] R. B. Young, reference at the end of this paper.

These inspections showed much of anthropological interest, though perhaps a large part of the observations were not relevant to the main object of the visit, which was the remains of the anthropoid ape. The results will be given very briefly.

The cliffs of the ravine and particularly those on the southern side of the river gorge show a series of caves, some of which are of large size and could well have been used for, and actually show traces of, primitive habitation. In and about the caves may be found chips and other indications of stone culture.

None of these caves so far as seen contained any paintings or other figures, but according to local information some such figures existed originally before quarrying commenced on a part of the cliffs facing the valley.

Similar flakes, rejects, scrapers and here and there implements, mainly of chert, but now and then also of quartz, were found scattered more or less thickly in the dried-up ravine, over the rocky surface above this ravine up to the springs, on the southern slope of the upper part of the gorge of the river near the "Blue Pool," and especially on the plateau of Buxton itself. It was possible to make a fair collection of these remains, and a much larger one could still be made in these localities, particularly outside of the inhabited part of the little settlement.

All these cultural remains, from the caves, gorge and upper and Buxton plateaus, belong evidently to one type, time and people; and judging from the forms as well as materials these people were probably the Bushmen. But these points need a study apart and the writer can give no definite conclusion.

A very interesting condition of affairs may be seen on the rocky surface above the upper portion of the ravine. The places can easily be found by following the pipes which carry water from the springs above down to Buxton. Here the hard limestone is largely exposed and the surface contains many irregularities and pits, some loose stones and patches of sandy soil from which grow thorny bushes and other vegetation. On the exposed base-rock are or were found numerous flakes and imperfect stone implements made evidently on the spot from chert, quartz and other material which was brought from somewhere else. In general these stones like those of the other parts of this neighborhood look fairly fresh to fresh, but now and then one finds a flake or implement which shows more or less weathering. The most interesting find here, however, was that of a considerable number of chips and more or less finished implements embedded to a varying degree—some slightly, some almost entirely, in the very hard surface rock, from which it was almost impossible to chisel them out without damage. Some such specimens have doubtless already become completely enclosed in the rock. And similar conditions were found later over a large patch on the plateau of the Buxton village. The explanation of this interesting phenomenon, which could be so easily misinterpreted, is quite simple. The flakes etc., were found lodging in the depressions on the surface of the limestone rock. This surface is partly inclined, partly level. During the rains the pits and hollows are filled directly or indirectly by rain water capable of dissolving some of the limestone and on evaporation the water would deposit its contents on the surface of the older rock cementing to this whatever might be lying in contact with the same. Such processes then, if repeated for a sufficiently long time would tend to embed in part or whole the cultural specimens. The latter are not being exposed through erosion of the old rock but are being embedded in the new, localized, superficial desposits.

THE QUARRY FOSSILS

The quarrying for the limestone was begun in the face of the cliffs and the same method is followed to-day. A very large amount of material has already been removed producing a large, roughly semilunar space, along most parts of which intensive blasting goes on. The depth of the quarry from the original rock face to the farthest part of the walls as they now stand, is about 300 feet, and for a considerable portion of this distance the workingmen have noted the large cave-crevice and also several tunnels filled in with the pinkish, less valuable rock. In the rock of these old holes and according to report also in the large crevice-cave, petrified remains of animals have been found on repeated occasions. The workmen speak of a petrified 'turtle,' eggs, and bones of various animals, particularly baboons. The majority of these specimens were lost in the operations, others were taken away by employés. A number of the baboon skulls and brain casts, however, found their way into the Cape Town Museum and other institutions. Since the find of the large ape's skull these specimens were brought together for purposes of study by Professor Dart, and were seen by the writer in his laboratory. They comprised thirteen specimens of the skulls and brain casts of moderate-sized apes, mainly if not entirely baboons, besides some fragmentary bones enclosed in rock. The skulls, more or less still in the rocky matrix, are all imperfect, nevertheless collectively there is enough for at least the most necessary observations. The brain cast, or rather casts of the cranial cavity, are remarkable and in one instance there is a perfect and beautiful specimen. They were evidently produced by the skulls when empty being completely filled with fine reddish and other extraneous material which then consolidated *in situ*, in the same way as happened with the contents of the tunnels or caves in which they lay. Upon discovery the less resistant bony parts of the skull are sometimes lost, leaving behind the more or less exposed and faithful casts. One of these specimens, as already mentioned, is a jewel, showing perfectly the size and form of the brain as well as the convolutions.

The eggs, one of which of yellowish uniform color and of about the size of a goose egg was still at the time of the writer's visit in the possession of Mr. Spiers, together with the 'turtle' and some other bones, are said to have come from the long cave, while the skulls, brains and bones of the monkeys occurred only in the filled-in tunnels, particularly in one the remains of which can still be seen in the northern wall of the quarry.

Another such cave-tunnel existed in the back or western wall of the quarry not far from the stalactite cave; and in this solidly filled hole, following a blast one day in the latter part of 1924, Mr. G. L. de Bruyn, one of the mine overseers, discovered in the broken rock something that looked like a larger petrified skull. From what he could see he thought it was possibly the skull of a young Bushman. Mr. de Bruyn saved the specimen and delivered it to Mr. Spiers in whose office it lay for some weeks.

It so happened that just about this time the fossil discoveries of the Buxton quarry were brought to the attention of Professor Dart by Miss Josephine Salmons, Student Demonstrator of Anatomy, and shortly afterwards Professor R. B. Young, who was informed of these finds by Dart, having an occasion to visit the location, brought the fossil in question together with some additional pieces[6] to the Johannesburg University.

In manipulating the pieces of rock brought back by Professor Young, Dr. Dart found that "the larger natural endocranial cast articulated exactly by its fractured frontal extremity with another piece of rock, in which the broken lower and posterior margin of the left side of a mandible was visible. After cleaning the rock mass, the outline of the hinder and lower part of the facial skeleton came into view; and a careful development of the solid limestone in which it was embedded finally revealed the almost entire face"—of a very interesting new form of anthropoid ape.

[6] First report by Dart. See Literature.

Some time after this Professor Dart visited the Taungs quarry himself, examined the conditions on the spot, secured a few additional less important specimens and left with a request that future finds be carefully watched for, and in case of anything of importance coming to light that he should be notified.

Meanwhile with the utmost care and application and success, Professor Dart completely cleaned the specimen, including the fragile teeth, without damage. For this work, which occupied him for over a month and which required most painstaking manipulation, Dart deserves the greatest credit. Soon afterwards he sent the first notice and description of the specimen to England. About the same time news of the find was broadcast by the telegraph, and at the recommendation of the writer the "Science News Service" of the National Research Council, Washington, sent Professor Dart a cable asking for reliable information on the subject, which in a day or two brought the following concise and satisfactory answer:

> "The *Australopithecus africanus* consists of two fragments. The endocranial cast is complete. The face was embedded in the limestone of an old cavern completely filled with lime-infiltrated sand. The cave is in the dolomitic Kaap Plateau, near the locality of Taungs, Kalahari, Bechuanaland. The skull was dolichocephalic. The face was leptoprosopic. The remains are those of a juvenile subject with first permanent molars erupted. The brain was a little larger than that of an adult chimpanzee. The sulcus lunatus of the brain is in a position approaching human. The brain shows marked temporo-parieto-occipital expansion. There is an absence of the prerolandic and postrolandic flattening. The supraorbital ridges on the skull are absent. The orbits are rounded. The nasal bones terminate distally above the line connecting the lower margins of the orbits. The upper dental arch is parabolic in shape. The canines are small; their diastema measures 3 mm. There is no diastema about the canines of the lower jaw. The lower jaw resembles anteriorly the Heidelberg jaw. It has no simian shelf. Its canines are small and in line with asymmetrical vertical incisors. The foramen magnum is well forward."

Before the writer's visit to the quarry, an additional portion of the tunnel which gave this valuable specimen had been blasted away, but some of it still remained and could be distinguished from the surrounding limestone by the slightly more pinkish rock. The place was demonstrated to the writer by the Mine Boss, Mr. Rielly, as well as by Mr. de Bruyn; but not much additional information could be gathered and a photograph of the spot failed, due to lack of sufficiently clear demarcation between the filling and the surrounding limestone. Mr. de

Bruyn believed he remembered that at the time the larger specimen was discovered there appeared in the broken rocks also what looked like a mixture of baboon and perhaps other bones. The old solid rock-filled cave or tunnel which gave the specimen was near the middle of the back wall of the quarry about 40 feet from the top and nearly the same from the foot of the wall; it measured several feet in diameter. It differed in no way in character or filling from other tunnels cut across during the operations. A good part of it has been blasted away since the discovery without giving anything additional.

NEW SPECIMENS

After examining what remains of the tunnel that gave the anthropoid skull and of the remnants of the large cave a short distance to the right of this, the writer was led to the northern wall of the quarry, where a part of the original limestone elevation abutting on the dry ravine to the north of it has been left standing. In this wall, a little over 30 feet from its base and about the same distance from the top, there could be seen the pinkish fillings of another tunnel, somewhat less than 3 feet in diameter. Upon fastening a rope above and climbing up with its help, it was possible to reach the now solidly filled cavity. Fragmented bones in the rock filling the cavity were found after a very little search, but with the uncomfortable position and great hardness of the rock it was impossible to remove anything except in small pieces. An effort was made then to drill a small hole just below the filling, in order to blast out a small portion; but the tools of the native who climbed up for the purpose and tied himself at the hole with a rope were so ineffective that the attempt was abandoned. Mr. Rielly then arranged for three successive small blasts about the filling, laying half a stick of explosive in a depression of the rock and covering it with mud. These explosions made much noise, but removed only small portions of the rock. However, enough was uncovered of the filling to see additional bones including half of a monkey (probably baboon) skull. The next day the writer worked on the exposure for several hours. He tried a cold chisel, but the rock proving too hard, a heavy hammer was hoisted up and piece after piece of the rock was broken off with the hammer. This work, necessitating a suspension against the middle of a vertical wall with only here and there a little edge or nook for the feet, was not easy, nor was it enjoyed for it was felt to be a sort of vandalism, it being impossible to obtain a single specimen unbroken. If it was persevered in for some time it was only for the purpose of seeing at first hand the real conditions.

These conditions were interesting enough. Although less than a cubic yard of the stone was removed by both blasts and the hammering, yet no less than five apparently baboon skulls or brain casts, besides many bones were uncovered. Unfortunately only one of the specimens was recovered in fairly good condition, the others, as well as all the bones being broken in numbers of pieces, and these so enclosed in the hard and heavy rock that nothing could be done for their removal. A beautiful half of what appeared to be a small baboon skull was left in the face of the rock for someone else who could come with a better outfit and remove the specimen without further damage.

A few hours of the work under these circumstances convinced the writer that here was a good-sized old tunnel which once served in all probability as a retiring place for dying baboons. Everything spoke against this being merely a hole into which the skeletal remains of the apes had been washed from somewhere else. The evidence indicated that the dying animals had crawled into the hole; that after their bodies had decomposed the skeletal remains were covered and the cavities of the skull were tightly filled with fine sand and silt blown or washed into the crevice; and that other bodies of apes kept on being added until eventually the whole became consolidated into one hard mass. There are doubtless in this tunnel still many specimens belonging to these apes, and there may be other such holes. Proper exploration, though laborious, would in this spot alone probably reap a good harvest.

A similar though larger solidly filled tunnel exists in the central proximal portion of the quarry which is being actively blasted away, and any moment there may be tapped additional holes or caves of this nature.

AGE

After the writer had seen and done in the quarry all that seemed possible, there came for consideration the important questions of age.

The Buxton quarry presents plainly several distinct geological phenomena. The first of these is the formation and age of the horizontally stratified old shales, which extend on both sides and probably also beneath the limestone deposit in which we now find the Buxton quarry. These hard shales are evidently very ancient, but they seem to bear, at least locally, no fossils by which their age could be more definitely gauged. Geologists regard them as Permian.

The next problem is the age of the limestone that occupies a basin or depression in the shales. This limestone is evidently also very old, but it in turn appears to offer no fossils by which its real age could be gauged.

A wholly different proposition from both of the preceding, however, is presented by the sand-limestone and other materials which fill the caves and tunnels in the limestone proper. This fill-stone and the other contents must plainly be younger than the surrounding matrix. There were first the shales, then the limestone, than a gradual formation of the caves and holes that eventually became the habitat or retiring place of the baboons and other creatures, which was followed by a doubtless very gradual filling, to which succeeded in time the consolidation of the blown- and washed-in material.

The point of essential interest is of course the date of the existence of the newly found great ape. What can be said with fair confidence in this connection is as follows:

The remains of the ape were found in a very similar place and under practically identical conditions as the remains of the baboons that occurred and still occur in the tunnel in the north face of the quarry. As the two holes and their filling and even their niveau were so much the same we cannot but assume their close relation in time. The anthropoid ape may therefore be said to have lived in this region contemporaneously with the forms of apes whose remains are now found under the same conditions in other parts of the quarry.

This important but evidently justifiable generalization brings us a step forward, for while of the great ape there is only one juvenile skull, of the lower apes there are already in the collection over a dozen skulls and intracranial casts, besides numerous fragmentary bones, and this series of specimens, largely of adults, should make the determination of the one or more species of these lower apes fairly easy. According to Dart, a study on these remains by S. Haughton was lately in press and may since then have appeared. And if it will be possible definitely to establish the species of these apes such identification should help considerably towards the formation of an esitmate as to their antiquity.

A valuable aid in this respect may be furnished by the apes that still live about this spot. A colony of baboons still exists in the wild state about Buxton, and members of it have occasionally been seen in Buxton itself. They are baboons of a moderate size, and a few adult males should furnish precious material for comparison.

To summarize, it may be said that the rock filling in which the great as well as the smaller fossil apes at Buxton were found, is certainly and perhaps very considerably younger than the mother rock of calcareous tufa in which it was formed; and that an identification of the smaller apes together with their comparison with the modern species of baboons still living in the region may be hoped to give in the near future a fair chronological estimate of the age of all the fossils.

THE SKULL

While visiting Professor Dart's laboratory, with his generous permission some observations were made on the large fossil skull itself. These few observations will here be given and should in no way forestall Professor Dart's intensive study of the specimen. They are merely the writer's incomplete impressions and measurements.

The skull, as well known, is that of a juvenile individual in the early part of permanent dentition. The specimen still has all milk teeth but in addition there are also, about fully erupted below and nearing this above, the four permanent first molars. The subject corresponds therefore to a human child of about six years of age but in years the ape-child was surely considerably younger.

The eminently successful cleaning of the specimen by Professor Dart permits of a good appreciation of the principal characteristics of the skull with its face and lower jaw and the impression is that the specimen in general and more particularly in the size of its teeth, including the permanent molars, approaches a chimpanzee; but the concavity of the face and the absence of supraorbital ridges remind one at the same time slightly of a young orang. Yet the general character seems closest to that of a young chimpanzee, particularly a female, in whom the supraorbital ridges would not be developed. But just how close is the resemblance or just what are the differences, must be determined by ample comparisons.

The detailed notes as made on the spot are given below. A large part of the brain cavity is exposed and fortunately, as in the case of the other fossils from the quarry, is filled with a solid cast which, though not as perfect as that in some of the baboons yet permits the observer to see the shape and size of the brain. This brain differs somewhat from the average brain of any of the existing great apes; but without detailed and numerous comparisons it is impossible to say whether individual chimpanzees or others might not be found to duplicate these characters.

The main features of the brain are its good development both in height and fullness in the parietal region, with a rather sub-medium development of the frontal parts; but direct notes on this also follow.

MEASUREMENTS AND NOTES ON THE SPECIMEN

Length of specimen, glabella ad maximum (anteriorly skull, posteriorly, where bone is missing, the intercranial cast), 12.4 cm.

Length of skull (allowing 3 mm.[7] for the maximum thickness of the missing occipital part), approx. 12.7 cm.

Maximum breadth of skull (estimated from the brain, allowing 3 mm. for the thickness of each parietal), approx. 9.5.

Cephalic Index, near *75*.

Glabella prominence well marked. No trace of supraorbital ridges. Posterior 3/5 of frontal (anti-bregmatic) brain surface partly covered by a remnant of bone, shows what appears to be patent metopic suture but no trace on bone (what there is of it) itself.

Maximum length of brain cast, approx. 12.–.

Maximum breadth of brain cast (½ =4.4+), 8.9.

Brain Index near *74*.

Maximum height of brain from floor of auditory meatus (with line connecting frontal and occipital lobes horizontal), approx. 7.7.

(Brain cast laid properly on its side against a vertical plane with the two poles at equal distance from the plane).

Maximum height of brain above a line connecting approximate centre of occipital with that of frontal lobe (again with specimen on its side and held against a vertical), 4.9 to 5.0.

Diameter right occipital to right temporal lobe, near 8.4.

NOTES: The brain had a well marked frontal rostrum.

The inferior depressions, due to the bulging roof of the orbits, are much more marked than in man, and somewhat more than in the average chimpanzee, gorilla or orang brain, but less so than in the fossil baboons from the same locality.

Cerebellum *well* developed. Occipital lobe (right) of cerebrum overhangs cerebellum slightly (with poles-line horizontal, about 3 mm.).

Face: Height of upper face, 4.9 cm.
Breadth of one–half of the face, 4.6.
Breadth of whole of the face, about 9.2.
(laid against vertical to middle of lower nasal border).
Diam. bet. inf. extremities of max-mal. sutures, 6.6.

Nose: 3.2 x 1.7 (ext.) (lumen somewhat smaller).
Interorbital diam., 1.3.

Orbits: R. orbit, maximum height, 2.8.
maximum breadth, 2.8.
(Neither in same axis as in man).

NOTES: All facial parts look rather delicate, but this may be due largely to sex, besides age; comparisons with female apes are very desirable.

No trace of nasal spine.

Teeth: Teeth approach those of chimpanzee and man—not gorilla.
Enamel high as in human; but forms of teeth and crown somewhat aberrant from human.
Milk canines distinctly larger and higher than incisors.

Lower jaw: Lower jaw thick throughout.
Maximum thickness of l. ramus, 1.85.
Height of symphisis, about 2.6.
(Lower part of whole jaw worn off; remaining part, near 2.3.)

CONCLUSIONS

The writer's conclusions, or rather impressions, concerning the Taungs find, are very simple.

The find is unquestionably one of great interest and scientific importance, for it extends the field of anthropoid apes in Africa far to the south where no trace of such apes was known of or expected before.

The antiquity of the find is not necessarily very great, and there is

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[7] Allowances based on measurements taken on closely comparable skulls of juvenile chimpanzee and orang.

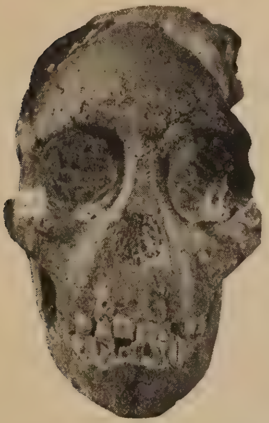

FIG. 1. Norma facialis of *Australopithecus africanus* aligned on the Frankfort horizontal.[1]

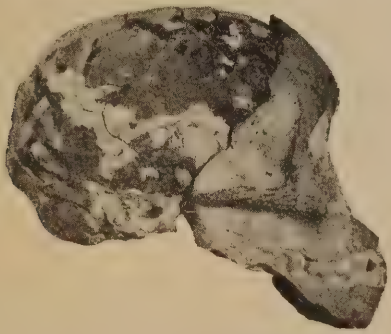

FIG. 2. Norma lateralis of *Australopithecus africanus.*

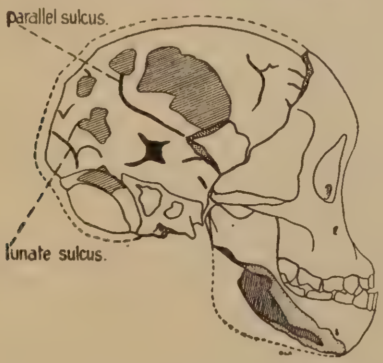

FIG. 3. Dioptographic tracing of *Australopithecus africanus* (right side), x ⅓

[1] The three illustrations here reproduced are those which accompanied Professor Dart's original report on the specimen, in *Nature* of Feb. 7, 1925. The blocks with a permission to use them were furnished to this JOURNAL by *Nature*, a courtesy which is hereby gratefully acknowledged.

substantial hope that before long with the help of the lesser apes it may be conclusively determined.

The skull itself is that of an anthropoid ape approaching rather closely in size and form the chimpanzee; but in all probability it is a new species, if not genus, of the great apes.

Just what relation this fossil form bears, on one hand, to the human phylum, and on the other to the chimpanzee and gorilla, can only be properly determined after the specimen is well identified, for which are needed additional and adult specimens.

As to its being the 'missing link,'—an expression, by the way, for which Dart though inclining that way is not wholly responsible—we may perhaps for the time being modify this and say with confidence that it is doubtless *a* missing link, one of the many still missing links in the realm of the Primate ancestry.

Fortunately the quarry that gave us this valuable specimen is not exhausted. Its old tunnels may still contain other and possibly adult examples of the great ape. It deserves to be closely and constantly watched and when possible, scientifically explored. Also, there are other similar deposits in this region and they too deserve close attention. South Africa gives much promise to Anthropology.

LITERATURE

Dart (Raymond A.)—Australopithecus africanus: The Man-Ape of South Africa. *Nature*, Feb. 7, 1925.
The Fossil Anthropoid Ape from Taungs. By Keith (Sir Arthur)—*Nature*, Feb. 14, 1925, CXV, p. 234.
———— By Elliot Smith (G.)—*Ibid.*, p. 235.
———— By Smith Woodward (Arthur)—*Ibid.*
———— By Duckworth (W. L. H.)—*Ibid.*, p. 236.
Keith (Sir Arthur)—The New Missing Link. *Brit. Med. J.*, Feb. 14, 1925.
Broom (R.)—Some Notes on the Taungs Skull. *Nature*, Apr. 18, 1925, CXV, pp. 569–571.
Young (R. B.)—The Calcareous Tufa Deposits of the Campbell Rand, from Boetsap to Taungs Native Reserve. *Trnsa. Geol. Soc. S. Africa*, XXVIII, 1925, pp. 55–67, 3 pl.
Sollas (W. J.)—The Taungs Skull. *Nature*, June 13, 1925, CXV, p. 908.
Keith (Sir Arthur)—The Taungs Skull. *Ibid.*, July 4, 1925, CXVI, p. 11.
Dart (Raymond A.)—The Taungs Skull. *Ibid.*, Sept. 26, p. 462.
Keith (Sir Arthur)— ——— *Ibid.*, pp. 462–3.
Wegner (Richard) — Der Taungs-Fund, ein jugendlicher Menschenaffe. *Die Umschau*, 1925, XXIX, No. 22, 429-433.
"M.B."—Nouveaux détails sur l'Australopithecus. *L'Anthropologie*, 1925, XXXV, Nos. 3-4, 402.

PREHISTORIC MAN IN CEYLON

JOHN STILL
Kandy, Ceylon

WITH INTRODUCTORY REMARKS BY A. HRDLIČKA

During my visit to Ceylon in May of this year, I made whatever inquiries and observations were possible on the subject of prehistoric man in that island. Anthropologically, as well as otherwise, this large island is in a strategic position. It could hardly have escaped any spread of man from southern India. If southern India had an early man (which, however, is still uncertain), then Ceylon should have received him also. And if early man reached Ceylon he must have left material remains, cultural as well as skeletal, of his occupation.

Of such remains, however, nothing is as yet known. No skeletal remains of geologically ancient man have ever been found. But the island with its numerous caves and ancient water-holes has never yet been properly explored.

What is well known is that various sites in the hills yield stone chips, with here and there an implement. These sites, though, are generally superficial, on the tops of ridges and elevations. The stones consist mostly of fresh-looking chips of quartz. The rare implements are chipped, never polished, and approach more or less the later palæolithic forms. They have not been found thus far in any geologically old strata, nor with the remains of extinct animals. Their nature, workmanship and relative freshness suggest no very ancient origin. There are two exhibition cases full of such tools (with rejects and chips) at the Colombo Museum. They are described as well as pictured in the "Spolea" of the Museum. So far they offer no satisfactory evidence of early man.

In visiting Kandy it was my good fortune to be taken by Dr. Pieris, the respected Judge of Kandy, and Dr. Nell, a well known local oculist and student of the natives, to Mr. John Still, one of the oldest whites in Ceylon, for many years in Government employ which took him to all parts of the island, and a keen, educated observer. With Mr. Still we spent a most interesting evening, full of information especially about the remnants of the Veddas and about the occurrence of stone implements. This first-hand knowledge was such that I asked Mr. Still to prepare me a brief written account of whatever in the island may point to man's prehistory; and the following well-written notes are the result. They settle nothing. They show no ancient man. But they tell, perhaps more clearly and authoritatively than has been done before, of the actual conditions as well as opportunities for exploration.

A. H.

Dr. Hrdlička of the Smithsonian Institution has asked me to put down on paper the substance of a conversation we had concerning the evidences of prehistoric man in Ceylon.

I will attempt to do so, but must preface that my observations have not been professional or systematic, but have been among the recreations of a man interested in all that stimulates wholesome mentality.

The observations have been made in a random fashion, and will be recorded in like manner. The inferences drawn from the things seen have grown very slowly, and are not dogmatically held. The result will be a paper intended to be, and it is hoped fit to be, a part of the stock of knowledge that some more serious inquirer may be aided with at the outset of some future inquiry into the whole question of primitive man in Ceylon.

The shape and situation of Ceylon have to be taken into consideration first, for it is probable that these have altered but little in the last hundred thousand years, despite a Sinhalese legend to the contrary. Ceylon is so shaped that its climate is, broadly speaking, divided into a region which receives the rains of the south-west monsoon and a region which does not. The civilization developed under Dutch and British rule during the last three centuries lies in the former, the sou'west monsoon region; and the civilization that gave birth to the old Buddhist cities known to archaeology lay in the latter, the dry zone. The probable reason of this is to be written in one word, MALARIA; for the map compiled by the government pathologist showing in different shaded areas the prevalence of malarial infection among school children might almost equally well be used as an illustration to show those areas where ancient Buddhist remains are most prevalent. A secondary reason is to be found in the crops raised. In the old days Ceylon grew its food supply under irrigation, water being carried down from the wet hills to great storage tanks in the dry plains and there distributed through an infinity of channels and lesser tanks to the fields. At present Ceylon buys its food, to a very large degree, by its exports of tea, coconuts, and rubber (formerly coffee and cinnamon), all of which are grown in the wet zone on natural and unstored rainfall.

Primitive man lived in both of these zones, and probably in the whole of each, for his remains are very widely spread if not universal. This is provocative of wonder whether malaria is comparatively a late comer to Ceylon. The present day Sinhalese certainly have not the grit to reconquer the malarious forests on the east and north; and it seems very doubtful if they were ever much more vigorous than they are at the present time. Despite all that has been said about them, their ancient buildings are not really in any way very remarkable. But whether earlier man had to contend with malaria or not, he wandered all over the island; and wherever he went he left chert and crystal chips to blaze his trail like boys on a paper-chase. These chips are to be found in almost any quantity desired, but very few indeed are actual instruments. They litter the hill tops, but only one in hundreds convinces one that it was definitely shaped for a definite purpose; though all have most obviously been brought up from the valleys as whole stones and knocked into slivers on the tops of the hills. Occasionally a core is found, but for the most part the discoveries are limited to waste chips, thrown away unwanted.

Crystal chips are vastly more common than chert chips in any area I have observed: perhaps one thousand times as common.

When the country as a whole definitely left the stone age behind it I am unable to say; but among the ruins of Sigiriya, a rock fortress of about the sixth century A.C., not only are quantities of iron tools, nails, and other articles found, but also steel.

Early records give accounts of two races in Ceylon before the coming of Vijaya, the first Sinhalese, in the fifth century B.C. These records are the Sinhalese historical books, the earliest of which dates from the fifth or sixth century A.C., but was founded on earlier works now perished: the legends current in their day and noted by the Chinese book collectors of the same period approximately: and the Ramayana, which is a good many centuries earlier, and perhaps was in existence before Vijaya. In all these mention is made of Yakkhas or Rakshasas, and of Nagas. And from the place names, from local legends still current, and from one other set of evidences, it appears that the Yakkhas occupied roughly the territory now occupied by the so-called Kandyans, and the Nagas the part of the island occupied by the low-country Sinhalese, and perhaps a part of the Easter Province. Ptolemy's map appears to bear this out too.

The other set of evidences referred to is the constant division of the Sinhalese nation into two races or sub-kingdoms from the earliest historical times up to the present day, when political rivalry keeps them widely apart. There are slight differences in the tongue; there are differences in the dress of both men and women; there are differences in the relative distribution of the castes; and there are differences in the religion which everywhere lies thinly buried beneath Buddhism. In fact the two divisions have all the appearance of being two allied but separate ancient races. Again to refer to their distribution, it suggests that the Nagas were the first comers, and that the Yakkhas were driven into them as a wedge, the Nagas being forced to retreat East and South of the central hills. Going further, and trying to connect with the earlier historical traditions of the Sinhalese, it seems worth hazarding a guess that the Kandyans are a Sinhala-Yakkha-Tamil compound, and the Low-country Sinhalese an East coast of India-Naga-Tamil compound, with as much or more Tamil than the others, but of later intermixture.

The implements should be examined by an expert to decide if they bear out this general division and if they carry it back into remoter ages than legend and history can probe.

The Ramayana gives a clew that may lead to the discovery of yet another pre-Sinhalese tribe; for it refers many times to the enemies of the on-coming Aryans as the "disturbers of sacrifices," obviously people who were antagonistic to the Arya religion; and among those thus reprobated are the Kinnaras, a semi-human folk, half beast. A very low and very distinctive caste of Sinhalese, the only caste whose men wear short hair, is known as Kinnarayo, the plural form of Kinnara. This name, taken in conjunction with the Ramayaya is suggestive, but it may by a coincidence. The Veddhas, often identified as the Yakkhas, seem to me to be indistinguishable from the more "jungly" Sinhalese, and I believe the Sinhalese are full of Veddha blood. In a country where sexual intercourse has for centuries been largely promiscuous racial distinctions tend to disappear rapidly unless fortified by topographical separation, as has been to some degree the case with the Kandyans and Low-country Sinhalese until recent years. Roads and motor bus traffic will soon wipe out any remaining physical differences.

The remains themselves have to be considered, and I am incompetent to do this, but I can describe where they *have* been found, and what is more, where they *may* be found.

All over the hills, in the Sou'west zone and out of it as well, crystal chips are very common. It is no use looking in the valleys or on the hill slopes; at least I have not seen any there; but wherever a little round hill overhangs a valley with a trickle of a stream in it chips will be found. Just on the cap of the hill, and if that rises again to a second summit, then on the cap of that again. In the jungle it is very difficult to find a stone at all, because of the leaf mould, but the tea estates, which were once coffee estates, offer a happy hunting ground; for their soil is kept weeded, and as tea is planted about four feet apart in holes dug eighteen inches deep the soil has been thoroughly turned up and the hidden crystals revealed. Where one finds cores they are always waterrolled pebbles, quite unlike the veins of crystal which occasionally outcrop on the hills. They are valley stones, but found *when chipped* on the tops of hills. They are common around Kandy between one and two thousand feet above sea level, and they are common on the hills in the Maskeliya district at five thousand feet and over. Those regions both get the sou'west monsoon, and Maskeliya at any rate appeared to be virgin forest; but the stones are equally common on every hilltop in the vicinity of Bandarawela hotel situated at about four thousand five hundred feet elevation in the zone which gets no sou'west. An enormous number of these Bandarawela chips have been described as *pigmies*, but possibly the whole subject should be reviewed by more expert if not more ardent collectors. Anyhow, the stones were brought to the hill tops and there chipped; when and why we do not yet know.

Another place where I should be inclined to look for prehistoric man in the hills is in the caves where the esculent swift's nests are to be found. There are plenty of such caves, and I do not think they have been explored.

But to return to the Bandarawela chips. The hills round Bandarawela are what is called *patna*, grass land. There are a number of such lands in the hills; e.g., the Horton Plains, which are not plains at all but a series of steep little valleys covered with short grass dotted with rhododendron trees and rising to over 7000 feet elevation: the Elk Plains, similar but not so high up: the Bo-pats, again the same, at about 5000 feet, and many more such "patna" lands. I do not know if many of these have been searched for chips, but I fancy not by anyone qualified to pronounce on them. My own impression, for what it is worth, is that these grass lands are the clearings of prehistoric man made after the discovery of fire. The Sinhalese burn such lands annually, in February generally when the grass is ripe, so that they will spring up fresh and green and provide feed for their cattle. They also burn them in the low country for another reason, in order that they may look for shed antlers more easily and with the danger of snakes minimised, so they have told me when I asked why they had done this apparently wanton thing, destroying hundreds of birds. For many years "patna" land was despised and avoided by planters. It had no forest, while the neighbouring lands had, and the inference was that forest would not grow there. But tea has now been grown successfully on many a "patna" land, and moreover it had been proved by the forest department that forest can be grown there too if it is protected from fires. In Ceylon, even in the dry zone in the driest weather, even when the grass is ripe and dried to a yellow hay, fire will not spread into the jungle. The trees do not catch fire. But, on the other hand young seedlings cannot resist fire; it is only when they grow big enough to shade the grass sufficiently to prevent it drying completely right up to their stems that they are safe. There remain the rhododendrons, and lower down the kahata trees; both of these kinds are found in "patnas," and their fire resisting capacity must be very great. But on the whole I do not think an area once deforested will reforest itself if men burn off the grass. The old abandoned coffee estates have shown no sign of so doing in fifty years. And it seems reasonable to say that the question of the "patnas" being prehistoric man's clearings is worthy of scientific investigation.

Another matter which is allied with the hill-top chips is the elephant roads. Up to seventy or eighty years ago elephants were common all over the region now occupied by the tea estates, and their roads are even now remembered in some parts. In the great forests of the highest hills and all over the forests of the plains wild elephants are quite common, and I have often travelled by their roads; for the elephant is an excellent road maker, and the forests of part of the Adams Peak range are so densely matted with the creeping bamboo that it is next to impossible to make a bee line through them; so one follows the elephant roads. Now these roads differ from human roads in one important particular, for they follow along the ridges whereas our own roads follow valleys. A human road or railway penetrating a hilly country from the low lands chooses a valley and follows it up through the hills, changing by a bridge from side to side wherever necessary; but an elephant would go differently; in all probability he would choose a spur, climb to its ridge, and find his way into the upper hills by pursuing each ridge until it connected with a range, and then continuing along the backbone of the range. It is not difficult to conceive his reasons for doing this, for valleys are liable to be boggy and an elephant fears marsh or swamp on account of his enormous weight. But the elephant's reasons are less my point than the man's. Man drains swampy valleys for the sake of the good soil to be found in them, and he makes his dwellings in the neighbourhood of his gardens or fields, and near water: so it comes to pass that his roads which follow thousands of years later follow the valleys too. But before man made fields or had permanent dwellings there was not this particular reason to stay in valleys; they were fuller of mosquitos, and being swampy were full of frogs, a very dangerous thing for the children, for where there are frogs there will be snakes. So, until he drained and occupied the valleys man probably avoided them like the elephant, but for different reasons. He therefore used the elephant's roads for the very same reasons that I did myself when exploring the Adams Peak ranges more than twenty years ago: it was easier and saved me from cutting paths; and man in the stone age did not want to waste his frail and valuable crystal tool on cutting paths when the elephants were able to save him the whole of the trouble. I mention this because I think I have observed an association of chip covered hill tops with elephant roads. Again, it is worth while investigating further, further than I have the leisure or training to go.

Now from the hill top chips it is necessary to pass to the chips of the plains; and a description of the country must be made first. From the foothills to the north and to the east plains stretch to the sea. They undulate slightly, and are really a series of shallow almost imperceptible valleys which were used in the first millennium A. D. for constructing reservoirs for irrigation. To the present day the only water on which human communities are based in by far the greater part of this region are so called tanks, reservoirs of stored water. There are a few places where the people rely on wells, but they are not in my story. The old buddhist civilization has perished, and this wide region has the appearance when viewed from the top of a hill of being an unbroken forest stretching for hundreds of square miles. It is pierced by a few roads and a few channels, and a few of the great storage tanks have been repaired; but for the most part the country is empty of human beings and has gone back to the condition it was in before the irrigation began to enable man to conquer the wilderness. For ages there was forest inhabited by bears, leopards, deer, pigs, elephants, and a host of lesser beasts: then for about fifteen centuries, more or less, irrigation tamed it and fields, villages, and cities sprang into being: then, in the thirteenth century A. D. it began to go back to the forest, and now it is much so as it was a thousand centuries ago. And it is the paradise of the hunter of big game; I have hunted there myself many and many a time. I have watched the herds of wild elephants in the glades, and heard their trumpeting while they quenched their huge thirst in one or other of the rare streams that do not dry up. I have sat in a tree and seen the deer drink at the narrow water-holes among the rocks; and where no suitable tree grew close enough to the hole I have sat on the rock itself behind a few boulders disposed as a rampart and seen bear after bear come down to the water's edge to drink, and in the difficult light of the moon I have seen the leopard steal silently from the shadows and sit by the waters side listening to the belling of the deer. And the deer in their herds have come with timorous step and stood in terror, afraid even to drink, while the wind bore to them tidings of their enemies in the woods around. I have done this, and so did primitive man.

It occurred to me very many years ago to look by the waterholes for chips, and in a number of instances I found them. For prehistoric man sat by the same holes for the same reason that I did.

These waterholes are usually clefts in an outcrop of gneiss, narrow and deep, able to hold water right through the drought for their catchment area of rock surface may be very large in proportion to their surface area; and a slight shower, too slight to let the floor of the jungle become really wet, may put a foot or more of water into them. They, and the very rare perennial streams, are the only source of water supply apart from the works of man. Englishmen hunt there for leopards and bears, and natives shoot deer at the waters edge although it is illegal. Prehistoric man unquestionably must have done the same.

Waterholes are often traps, for their edges become polished like glass by the feet of the animals; then they evaporate, or are sucked up by herds of elephants, and the water sinks until the animals have to stoop and stretch to get down to the precious liquid, and sometimes they fall in. I have seen a live wild elephant in a waterhold, a prisoner unable to escape. I have seen a smallish crocodile in a waterhole lying belly upwards and slashed by a leopard's claws so as to be practically disembowelled. I have seen a bear dead and drowned in a waterhole; and in the mud at the bottom of one that had dried up I have seen the antlers of two sorts of deer and the bones of wild boars. For there is always mud at the bottom of these holes, sometimes a great depth I think.

It is easy to imagine what a field of discovery awaits any one who makes a thorough study of prehistoric man's relics in waterholes; and properly dated too by the gradual accumulation of the mud. How often he must have lost his arrow, his knife, his spear head, his ornaments, his pottery, and perhaps even his children in waterholes. I do not think any search whatsoever has been made except my own slight observations mentioned here. Sometimes by waterholes there are rude shelters of unshaped stones to be found: I have used old ones, and made new ones myself: and so did the earliest men, for the same reason, to hide their presence from the animals coming to drink.

TIME OF OSSIFICATION OF THE BONES OF THE HAND OF THE MALE AND FEMALE

AND

UNION OF EPIPHYSES WITH THE DIAPHYSES

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In the course of my research on the time of appearance of centers of ossification in the bones of the carpus, and on the union of the ephiphyses of the metacarpals, phalanges, the distal extremity of the radius and that of the ulna, I have found marked differences in the time element between the male and the female. I suppose these differences are just what one should expect, knowing that the female is developed in many ways sooner than the male.

There are instances of normal early ossification in both sexes, and there are normal cases in which ossification is delayed. In either instance I believe this is due in the main to heredity. I have followed a few of these cases of what may be called precocious and delayed ossification, and I think they are family characteristics.

Differences such as those here to be dealt with are found already in the embryo, the foetus and the new born child, and so on to the full development. In other articles published I have given the result of the study of over seven hundred roentgenograms, giving the time of appearance of centers of ossification and the chronological order of ossification. In the embryo the time of appearance of many of the centers of ossification has been well established by other investigators, but the difference in the sexes was not noted.

The studies here reported are based on carefully made roentgenograms of 64 white males, of 12 y. 6 mo. to 22 y. 10 mo. of age and 81 white females, 12 y. to 22 y. 6 mo. of age. In all the plates I have recorded the date of birth and the date when the plate was made, thus giving the exact age in years, months and days.

I have been asked, why the days, weeks, and later even the months? A very little study of the subject will show why the days in the embryo. Mall states the first point of ossification appears in the clavicle in the sixth week; there is then a rapid development, following in a few days of other points, and in a few weeks a large number have made their appearance. Such conditions follow throughout the intrauterine development, so that this is measured at first by days, then weeks, then months. Then after birth why the weeks and months? The capitatum rarely shows a center of ossification before birth but the time of its appearance is measured by weeks and months. In the female it will have appeared in practically all cases when the child is six months of age and in the male by the tenth month. We may note in a film or plate an absence of beginning ossification of any of the bones, yet if a film is made a few days later it may show clearly beginning ossification. This in my opinion is of no small importance. When we consider the presence and the union of epiphyses from a surgical viewpoint, no one knows better than an experienced roentgenologist how important it is to know with reasonable accuracy the time of appearance of the epiphyses and their union with the shaft of the bone.

The first evidence of ossification of any of the epiphyses is seen as a pin point of bone tissue. This gradually enlarges and approaches the form of the bone. In the phalanges the ossifying "centers" soon become disc shaped and persist as such until fusion with the diaphysis, finally showing a faint line at the situation of union. When the union is complete the texture of the bone shows no further sign of demarcation.

The ossifying epiphyses of the metacarpal bones soon become round and persist in this form until they assume the shape of the end of the bone. The line of union of these epiphyses with the diaphyses is different from that in the phalanges. This line of union is always irregular and shows a zigzag appearance, until the texture of the bone can be seen, in complete union. This does not apply to the metacarpal bone of the thumb in which conditions are somewhat like those of the phalanges.

The individual data obtained in the present studies and their summary, are given briefly in the following tables:

UNION OF EPIPHYSES

No.	Age y m d	Sex	Distal end of Radius	Ulna	Metacarpals	Phalanges
1.	12–6–0	M	Distinct	Gap[1]	Distinct Gap	Distinct Gap
2.	12–9–4	"	"	"	" "	" "
3.	12–10–0	"	"	"	" "	" "
4.	12–10–21	"	"	"	" "	" "
5.	13–3–6	"	"	"	" "	" "
6.	13–7–25	"	"	"	" "	" "
7.	13–9–5	"	"	"	" "	" "
8.	14–10–6	"	"	"	" "	" "
9.	14–6–16	"	"	"	" "	" "
10.	15–2–19	"	"	"	" "	" "
11.	15–6–28	"	"	"	" "	" "
12.	15–11–25	"	"	"	Distinct gap in all	D. G. in all
13.	16–4–18	"	"	"	Indistinct gap in all	I. G. in all
14.	16–4–11	"	"	"	Distinct " " "	Distinct gap in all
15.	16–10–25	"	"	"	Distinct " " "	D. G. in all but 2d 3d row line

16.	16–10–25	"	D. gap	I. gap	I. G. in all	I. G. in all
17.	17–2–10	"	I. gap	" "	Line in all	Line in all
18.	17–4–20	"	United	United	United in all	United in all 3d row line
19.	17–5–28	"	D. gap	D. gap	" " "	" " "
20.	17–5–0	"	" "	" "	D. G. in all	D. G. in all but 3d row line
21.	17–6–13	"	" "	" "	" " " "	D. G.in all
22.	17–7–14	"	" "	" "	" " " "	" " " "
23.	17–7–16	"	I. G.	I. G.	United in all	United in all
24.	17–8–1	"	Distinct gap		Distinct gap in all	D. G. in all
25.	17–8–7	"	Indistinct gap		United in all	United in all
26.	17–9–15	"	D. G.	I. G.	Line in all	Line in all
27.	17–1–0	"	D. G.	D. G.	" " "	" " "
28.	17–9–0	"	I. G.	Line	United in all	United in all
29.	17–6–15	"	D. G.	I. G.	" " "	" " "
30.	17–11–18	"	" "	" "	I. G. " "	" " "
31.	18–0–0	"	" "	" "	D. G. " "	I. G. " "
32.	18–0–9	"	" "	United	United " "	United " "
33.	18–1–2	"	" "	I. G.	" " "	" " " 3d row line
34.	18–1–23	"	" "	" "	" " "	" " "
35.	18–2–16	"	" "	D. G.	D. G. " "	D. G. " " 3d row line
36.	18–2–21	"	" "	" "	United " "	I. G. " "
37.	18–3–23	"	" "	" "	" " "	United " "
38.	18–5–20	"	" "	" "	" " "	" " "
39.	18–5–14	"	" "	I. G.	" " "	" " " but 3d row line
40.	18–6–11	"	I. G.	" "	" " "	" " "
41.	18–7–0	"	" "	United	Line " "	Line " "
42.	18–10–10	"	D. G.	I. G.	I. G. " "	I. G. " "
44.	19–1–10	"	" "	United	" " " "	" " " "
45.	19–3–1	"	" "	I. G.	" " " "	" " " "
46.	19–4–20	"	I. G.	United	" " " "	United " " but 3d row line
47.	19–5–17	"	" "	"	" " " "	" " "
48.	19–6–21	"	" "	"	Line " "	" " "
49.	19–11–5	"	United	"	United " "	" " "
50.	19–11–18	"	"	"	" " "	" " " 3d row line
51.	20–0–19	"	Line	"	" " "	" " "
52.	20–1–15	"	United	"	" " "	" " "
53.	19–0–6	"	Line	"	" " "	" " "
54.	20–3–29	"	United	"	" " "	" " "
55.	20–5–22	"	"	"	" " "	" " "
56.	20–5–21	"	"	"	" " "	" " " 3d row line
57.	20–5–22	"	"	"	" " "	" " "
58.	21–1–9	"	"	"	" " "	" " "
59.	21–4–16	"	"	"	" " "	" " "
60.	22–5–18	"	"	"	" " "	" " "
61.	22–5–20	"	"	"	" " "	" " "
62.	22–6–0	"	"	"	" " "	" " "
63.	22–8–0	"	"	"	" " "	" " "
64.	22–10–0	"	"	"	" " "	" " "
1.	12–1–9	F	Distinct gap		Distinct gap	Distinct gap
2.	12–5–9	"	"	"	" "	" "
3.	12–7–9	"	"	"	" "	" "
4.	13–10–17	"	"	"	" "	" "
5.	13–11–10	"	"	"	" "	" "
6.	14–3–21	"	"	"	United in all	Line in all
7.	14–3–10	"	"	"	Distinct gap in all	Distinct gap in all
8.	14–4–6	"	"	"	" " " "	" " " "
9.	14–4–9	"	"	"	United in all	United in all
10.	14–5–16	"	"	"	" " "	" " "
11.	14–6–0	"	"	"	Faint line in all	Faint line in all
12.	14–6–23	"	"	"	United in all	United in all
13.	14–7–11	"	"	"	Indistinct gap in all	Line in all

UNION OF EPIPHYSES—*Continued.*

No.	Age y m d	Sex	Distal end of Radius	 Ulna	Metacarpals	Phalanges
14.	14–8–13	F	Distinct	gap	Distinct gap in all	Distinct gap in all
15.	14–9–4	"	"	"	" " " "	" " " "
16.	14–10–15	"	"	"	Indistinct gap in all	Faint line in all
17.	14–10–0	"	D. G.	I. G.	I. G. in all	Line in all
18.	14–10–8	"	D. G.	D. G.	" " " "	" " "
19.	14–10–15	"	" "	" "	D. G. " "	D. G. " "
20.	15–3–7	"	" "	I. G.	United in all	United in all
21.	15–6–6	"	" "	" "	" " "	" " "
22.	15–6–20	"	I. G.	United	" " "	" " "
23.	15–6–21	"	D. G.	D. G.	Distinct gap in all	I. G. in all but last row line
24.	15–8–21	"	" "	I. G.	Line in all	United in all
25.	15–7–21	"	" "	" "	United in all	" " "
26.	16–0–14	"	" "	" "	" " "	" " "
27.	16–1–9	"	" "	" "	" " "	" " "
28.	16–2–27	"	Line	United	" " "	" " "
29.	16–3–3	"	"	"	" " "	" " "
30.	16–3–15	"	"	Line	" " "	" " "
31.	16–4–21	"	I. G.	"	Line in all	Line in all
32.	16–6–24	"	D. G.	I. G.	Indistinct gap in all	I. G. in all
33.	16–7–0	"	Line	United	United in all	United in all
34.	16–9–21	"	"	"	" " "	" " "
35.	16–9–2	"	"	"	" " "	" " "
36.	16–9–0	"	"	"	" " "	" " "
37.	16–10–0	"	D. G.	D. G.	" " "	Line " "
38.	17–0–0	"	Line	United	" " "	United " "
39.	17–0–24	"	D. G.	I. G.	" " "	" " "
40.	17–2–14	"	Line	United	" " "	" " "
41.	17–2–12	"	"	"	" " "	" " "
42.	17–3–21	"	United	"	" " "	" " "
43.	17–4–2	"	"	"	" " "	" " "
44.	17–6–0	"	"	"	" " "	" " "
45.	17–8–22	"	Line	"	" " "	" " "
46.	17–8–11	"	United	"	" " "	" " "
47.	17–8–19	"	Line	"	" " "	" " "
48.	17–9–11	"	United	"	" " "	" " "
49.	17–10–26	"	"	"	" " "	" " "
50.	17–11–24	"	"	"	" " "	" " "
51.	17–6–17	"	"	"	" " "	" " "
52.	17–10–25	"	"	"	" " "	" " "
53.	17–11–0	"	"	"	" " "	" " "
54.	17–11–10	"	"	"	" " "	" " "
55.	18–1–14	"	"	"	" " "	" " "
56.	18–3–14	"	Line	"	" " "	" " "
57.	18–3–24	"	United	"	" " "	" " "
58.	18–3–13	"	"	"	" " "	" " "
59.	18–5–0	"	"	"	" " "	" " "
60.	18–7–0	"	Line	"	" " "	" " "
61.	18–8–0	"	"	"	" " "	" " "
62.	19–0–22	"	United	"	" " "	" " "
63.	19–0–16	"	Line	Line	" " "	" " "
64.	19–0–10	"	United	United	" " "	" " "
65.	19–4–3	"	"	"	" " "	" " "
66.	19–4–3	"	"	"	" " "	" " "
67.	19–5–0	"	Line	"	" " "	" " "
68.	19–6–65	"	"	"	" " "	" " "
69.	19–7–0	"	United	"	" " "	" " "
70.	19–7–13	"	"	"	" " "	" " "

71.	19–11–18	F	Line	United	United in all	United in all
72.	20–0–17	"	United	"	" " "	" " "
73.	20–1–22	"	"	"	" " "	" " "
74.	20–3–5	"	"	"	" " "	" " "
75.	20–6–13	"	"	"	" " "	" " "
76.	20–8–2	"	"	"	" " "	" " "
77.	20–10–10	"	"	"	" " "	" " "
78.	21–5–10	"	"	"	" " "	" " "
79.	22–2–0	"	"	"	" " "	" " "
80.	22–0–8	"	"	"	" " "	" " "
81.	22–6–2	"	"	"	" " "	" " "

[1] Abbreviations: D. G. = distinct gap.
I. G. = indistinct gap.

With the male hand I gave special attention to the ages of sixteen to twenty inclusive, in which we had forty-five roentgenograms, and with the female hand to the ages of fourteen to seventeen in which we had forty-nine roentgenograms.

Analysis of the data shows a distinct *cartilaginous gap* between the epiphyses and diaphyses in the hands of both male and female under thirteen years of age. In a few instances there may be found an indistinct gap between the epiphyses and the shaft of the phalanges of the first row in the female hand, indicating that union is taking place in the phalanges before that of the metacarpal bones. However I am inclined to think that complete union will be found in the terminal phalanges after it takes place in the others.

The sequence of union is not the sequence of development.

After the age of fourteen and up to fifteen, we find in the female hand complete union of all of the epiphyses of the hand, with the exception of those of the distal extremity of the radius and ulna, in many instances. In others the gap has been narrowed to what we call an indistinct gap, and in others only a faint epiphyseal line is seen, while in the male hand there is a *distinct gap* in every instance.

In the female hand from the age of fifteen to sixteen the union is complete in many individuals and when not complete only a faint epiphyseal line is seen, while in the male hand a *distinct gap* is seen with a very little narrowing in a few cases.

From the sixteenth to the seventeenth year in the female the union is complete in all the epiphyses expect those of the radius and ulna, and many of those of the ulna show complete union, and only a faint epiphyseal line is seen in the radius, while in the male a *distinct gap* is present in all but a few instances where we find an indistinct gap and no evidence of complete union.

In the female at the age of seventeen years and three months, the union is complete in all the epiphyses including those of the radius and ulna. Only nine of the remaining thirty-nine in the series of sixty-one hands show a faint epiphyseal line at the radius, while in the male hand at the age of seventeen years and three months *none* of the epiphyses show complete union with the shaft. It is only in rare instance that complete union is shown by the nineteenth year in the male hand. At twenty years of age or soon after the union seems complete in the male hand. The earliest hand of the female too shows complete union of the metacarpal epiphyses and the phalangeal epiphyses is that of No. 6, 14–3–21. The earliest in the male hand is that of 18, 17–4–20. The slowest in development in the female hand is that of 39, 17–0–24, in which there is a distinct gap at the radial epiphysis and an indistinct gap at the ulnar epiphysis but the metacarpal and phalangeal epiphyses have united.

The slowest in the male hand is that of No. 48, 19–6–21.

A careful study of these roentgenograms, and I believe this would be the same if we had an unlimited number, will show a difference of three years in the sexes in a large majority of the cases and a difference of four years in others.

The chronological order in which the bones of the carpus are ossified does not seem to differ, materially, in the sexes.

CHRONOLOGICAL ORDER

Male

	Capitatum	Hamatum	Triquetrum	Lunatum	Navicular	Lesser Multangular	Greater Multangular	Pisiform
First in order	*114*	2						
Second	2	*112*						
Third			*94*	11				
Fourth			8	*79*	1	2	2	
Fifth				3	*25*	13	*17*	
Sixth				1	10	*13*	8	
Seventh					2	4	*12*	
Eighth								

Female

	Capitatum	Hamatum	Triquetrum	Lunatum	Navicular	Lesser Multangular	Greater Multangular	Pisiform
First in order	*111*	2						
Second	2	*111*						
Third			*107*	2				
Fourth			2	*79*	2	7	5	
Fifth				4	*43*	21	11	
Sixth				1	13	*34*	22	
Seventh				6	15	12	*29*	
Eighth								1

I have compiled the preceding from a former published table in which I gave the size of the centers of ossification and the order in which they appeared. These include in the female the ages of three months and eight days to eight years, and we have one hundred and thirteen cases. With the male hand we have one hundred and sixteen individuals, from seven months and twelve days to eight years.

Matters seem to be following the same order until we get to the greater and lesser Multangular. In the female hand the lesser Multangular has thirty-four in the sixth position to twenty-two for the greater Multangular, while in the male hand the lesser Multangular has thirteen to eight for the greater Multangular, but the latter has seventeen in the fifth position and the lesser Multangular has thirteen. You will note, however, that while the greater Multangular has seventeen in the fifth position, the Navicular has twenty-five in this position in the male hand and the female has forty-three.

I am inclined to think this frequency of finding the greater Multangular in the fifth position in the male hand is the reason we find in our standard text books of Anatomy the fifth position given to this bone. In the early editions of Gray this bone was given as the fourth to appear but later on this was changed to the fifth position. And it has remained in this position for many years.

It is just possible that the proper position of the greater Multangular in the male hand is the sixth, certainly not the fifth, and its proper position is undoubtedly the seventh in the female hand. If this difference of chronological order exists, then we have another difference in the ossification of the male and female skeleton. These marked differences in the ossification of the male and female skeleton are easily proven. Let any roentgenologist take a film of the hand of a brother and sister twins at five years of age or a brother at five and a sister at three years of age. The advanced ossification in the female hand is easily seen.

I select the age of five for the male and three for the female in brother and sister because the differences in ossification in the sexes are so plainly seen at this period. I have several sets of twins of the same sex and twins of the opposite sex. These differences apply not only to ossification of the bones of the carpus but to the epiphyses of the metacarpal bones, those of the phalanges and those of the radius and ulna. These marked differences continue until we have the union of the epiphyses with the diaphyses which takes place three to four years sooner in the female than in the male.

I have only investigated the question of unions of the epiphyses in connection with those of the hand, but have expressed an opinion as to the time of appearance of the epiphyses at the distal extremity of the femur, and the proximal extremity of the tibia.

In a few instances in which I found an unusual early union of the epiphyses of the hand, I have made plates of the elbow, knee and ankle. In all of these I found a corresponding early union of these epiphyses. The bones of the tarsus, the metatarsus and the phalanges of the foot ossify earlier than those of the hand.

We frequently find large centers of ossification in the calcaneum and talus before birth. A center of ossification in the cuboid is frequently found before birth and there is the same difference in the male and female skeleton that we find in the hand.

To quote from Stevenson, "The extent to which the venerable hand of tradition still controls our teaching on the subject of the time element

Time of Appearance of Centers of Ossification in the Epiphyses of the Hand

Metacarpal	First		F Early in third year
			M Early in third year
	Second		F Late in first year
			M Early in second year
	Third		F Early in second year
			M Late in second year
	Fourth		F Early in second year
			M Late in second year
	Fifth		F Early in second year
			M Late in second year
Phalanges	Middle	1st row	F Late in first year
			M Early in second year
		2d row	F Early in second year
			M Late in second year
		3d row	F Late in second year
			M Late in third year
	Ring	1st row	F Early in second year
			M Late in second year
		2d row	F Early in second year
			M Early in third year
		3d row	F Late in second year
			M Late in third year
	Index	1st row	F Early in second year
			M Late in second year
		2d row	F Early in second year
			M Early in third year
		3d row	F Late in second year
			M Late in third year
	Little	1st row	F Early in second year
			M Late in second year
		2d row	F Late in second year
			M Early in third year
		3d row	F Late in second year
			M Early in third year
	Thumb	1st row	F Late in second year
			M Early in third year
		2d row	F Early in second year
			M Late in second year
Radius			F About eighth month
			M About 15th month
Ulna			F Bet. 6th and 7th yr.
			M Bet. 7th and 8th yr.

in epiphyseal union is seen in the frequency with which expressions found in the earliest editions of well known texts are retained practically verbatim in some of the latest editions of these same works."

Why should our standard text books of Anatomy continue the statement year after year that the epiphyses of the metacarpal bones and the phalanges of the hand appear "about three years" or "third to fifth year," when many of these points appear in the female hand before the child is one year of age, others before two years and in many instances all have appeared before three years of age.

In the male hand a large number have appeared before the child is three years of age. The table on Epiphyses is the result of the study of sixty-four female and sixty-three male hands under six years of age.

I must, however, take issue with the statement made by Stevenson that the findings in the study of radiograms are not reliable. It is my opinion that the X-ray is the most reliable method we have.

In good roentgenograms the texture of the bone is shown and the very faintest epiphyseal line may be seen showing an incomplete union. I do not believe this could be as plainly seen by the naked eye in the dried subject. The exact age in years, months and days can be obtained in the living subject. I regret that the author saw fit to state that I made the assertion "that epiphyses in the female unite three to four years earlier than in the male without any confirmatory evidence." Of course he did not see my publication of 1916.

I made the statement to which he refers, after the investigation of the one hundred and forty-five roentgenograms given in Table 1.

I think the hand is a very good index to the entire skeleton. I do not mean by this that all of the epiphyses are united when we find those of the hand united, but when this takes place early in the hand there is a corresponding early union of the other epiphyses and the marked difference between the male and female are seen to be present.

In many instances the hand of the female is found to be four years in advance of the male, and in the majority of instances the female is three years in advance of the male when completely developed. This applies not only to the appearance of points of ossification but to the union of epiphyses of the hand and the natural conclusion is it applies to all of the epiphyses of the skeleton.

SUMMARY AND CONCLUSIONS

The ossification of the bones of the female is in advance of the male from time of appearance of centers of ossification in the Embryo. The difference is more apparent as the Fetus develops. After birth the differences are still more marked until the union of the epiphyses with the diaphyses.

The appearance of centers of ossification in the epiphyses of the metacarpals and phalanges in the female hand are decidedly earlier than in the male hand. A few have made their appearance in the female before the close of the first year and nearly all have appeared before the close of the second year; while in the male hand the most of them appear late in the second year or early in the third year.

The order of ossification of the bones of the carpus is apparently the same in the sexes.

The examination of 81 roentgenograms of the hands of females from 12 to 22 years of age, and 64 roentgenograms of hands of males from 12 to 22 years of age show that the union of the epiphyses with the diaphyses takes place from three to four years sooner in the female than in the male.

The hand is a good index of the extent of ossification in the entire skeleton, an early union of the epiphyses of the hand indicates a corresponding early union of all of the epiphyses.

LITERATURE

Bardeen, (C. R.)—Text Book, Human Embryology. Keibel and Mall. Vol. 1, 389–390.

Mall, (F. P.)—On Ossification Centres in Human Embryos. *Am. J. of Anat.*, Vol. V, 1906.

Stevenson, (Paul H.)—Age order of Epiphyseal Union in Man. *Am. Jour. Phys. Anthrop.*, 1924, vii, 53–94.

Pryor, (J. W.)—Development of the Bones of the Hand. *Bull. State College of Ky.*, 1905.

Pryor, (J. W.)—The Chronology and Order of Ossification of the Bones of the Human Carpus. *Bull. State University of Ky.*, 1908.

Pryor, (J. W.)—Some Observations on the Ossification of the Bones of the Hand. *Bull. University of Ky.*, 1916.

Pryor, (J. W.)—Differences in the Time of Development of Centers of Ossification in the Male and Female Skeleton. *The Anatomical Record*, Vol. VIII, 1922, 252–273.

TENDO OCULI AND PARS ORBITALIS IN DIFFERENT RACES

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A. Dissections

I. ORIGINS AND RELATIONS OF THE TENDO OCULI

The attachment of the tendo oculi, studied in human bodies, shows a variation as to origin, either from the maxilla (as stated in text-books) or from the naso-maxillary suture and its intersutural membrane. Its inferior margin is also important to describe, as it sheds light upon the problem of platysma migration. The tendo oculi, in the dissection of the Japanese subject, was attached to the tissue between the nasal bone and the maxilla. Its inferior margin was free, as though down-folded, the free edge extending for 8.5 millimeters from the naso-maxillary suture (sinistrad) to the few, inferiorly arising fibers near the medial palpebral canthus. The measurement is greater than usually determined; but the osseous landmarks have not modified since the first denudation, and by measuring from the suture there is likelihood of exactness. The beveling of the nasals and the maxilla as given by Piersol will also require allowances.

The Japanese subject is that of the Anatomical Collection, Museum number 5, Polhemus subject number 135. I have preserved the head in a crock. The structures of the left facial areas were dissected during May, 1920, for presentation to the first year class in anatomy, the entire body being studied by demonstrators and the various muscles being assigned to the members of the class. The right side of the face was dissected subsequently for comparison with the arrangement I had found upon the left orbit.

The origin of the tendo oculi on the left side, as stated, differs from other dissections, as the intersutural membrane situated in the naso-maxillary suture and associated by direct continuity with the periosteum, forms the definite point of attachment, but whether from os nasale or from os maxillare cannot be said. But as muscles in their variations, traced from one species to another, frequently come to arise from joint capsules, this instance would take a corresponding value, the exact relation of which I postpone for discussion at the end of the article.

There are always some fibers of the sphincter sweeping into the inferior palpebral rings which take origin, not from the tendo oculi, but from the

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bony external aspect of the naso-frontal process of the maxilla (1). In this Japanese subject (M—5), the upper margin of the tendo oculi gave a set which became marginal in the lower lid, descending entad to the tendo oculi and sweeping laterad to form a marginal set such as Riolano described. These were not distinguished from the fibers more peripherally situated, either by different color, or by the usual bunching at the palpebral fissure. The nerve supply was from the same set of rami zygomatici, and the color, as noted by Piersol (1) in his text, page 484, was light, both for the marginal fibers arising from the ental aspect of the tendo oculi, and for the more peripheral fibers of the lid, arising from the bone, inferiorly. The upper set of fibers arising from the tendo oculi exhibited the three-fold grouping as stated by Hans Virchow, (2) and usually seen. Some ascend to the corrugator; some ascend and sweep around the periphery of the orbit; and some, the third group, or upper marginal, a well-marked set arising like the preceding groups from the upper edge of the tendo oculi, pass laterad with the second group. This arrangement or origin of fiber groups, always from the upper edge, gave to the tendo oculi the effect of a folded sheet, the lower edge being ectal and free, although laid downwards.

In the dissected relations, we note that the pars malaris (3) crosses from below upwards, sweeping up to the corrugator, and carrying its associated structures, the angular vein downwards and the nerve from the inferior zygomatic rami upwards. The artery was not injected. There was no connection between the muscle fibers of the tendo oculi and those of the superimposed muscle bundle. Such a connection is found represented by recurrent fibers from the ligamentum palpebrale mediale to the ascending bundle in some types of sphincter, however.

The tendo oculi after being studied was cut at origin and the underlying structures found to be represented by a proper pars lacrimalis, the nerve supply of which was not found. But the relation of the inferiorly sweeping fibers arising from the upper and ental area of the ligamentum was further studied.

Hale and Pedersen (and Brockway) (4) state that the descriptions of Horner and of Henle give a length of "two lines" to the tendo oculi. This would be true in some dissections for the free length of the ligamentum. But if the portion giving rise to canthal fibers and the portion giving rise to fibers from the upper and the lower edges of the ligamentum be included, the total measurable length increases.

Upon the right orbit of the Japanese (M—5) I found: First, the fibers of the orbicular muscle sprang from both the upper and the lower margins of the muscle tendon (ligamentum palpebrale mediale as reflected across the maxilla). This harmonious radiation was carried along both edges almost to the point upon the naso-frontal process of the maxilla at which the tendo took origin. Second, the obliquely directed fibers of the fasciculus medialis of the upper lid were fewer in number. These obliquely placed fibers of the left side are especially described under a subsequent heading as pars orbitalis and diagonal fibers in the upper lid. Third, the tendo oculi attached three millimeters laterad to the line of the right naso-maxillary suture, instead of being directly in its groove, as upon the left side.

Comparison with dissections upon a negro, male, (B—274) shows that the tendon arises from the groove on the frontal process of the maxilla, in this instance from a marking often in line with the little accessory periophthalmic foramina. We see, also, a different arrangement of the fibers of the tendo oculi. It arises four millimeters from the naso-maxillary suture. It has a brief free inferior margin. From the portion entad to this arise inferior palpebral fibers, and also from the lateral portion of the lower edge directly come the fibers of the pars ciliaris. The free edge is about one and a half millimeters long, and directed angularly upward and laterad (right eye) while the tendon itself here measures three to four millimeters (body measurements after preservation with standard injection).

The superior margin of the tendon in this negro shows a not infrequent bundle which starts out and up and curves in a spiral around and in to pass downward, fused with the pars malaris, which is sweeping upward (and ectad to the ligamentum palpebrale) on its way to join the corrugator. In the arc developed, the termination of two nerve filaments takes place. These come up from the inferior rami zygomatici, after communication with the fifth and the plexus by small strands, and send short radiating branches to the fibers of this spray of arcuate muscle fibers. On the ental aspect of the spray is found a descending branch with its distributing filaments from the supra-trochlear nerve.

From the upper edge and lateral margin of the tendon, we have a radiating set of fibers, the highest and most mediad curving around and passing downward in the ascending malaris, and from this group more and more diverging fibers at a tangent to the arc pass up and then out to enter the rings of the upper palpebral fasciculus, some having passed up and into the corrugator before the radiations gain a lateral direction. There are, in the main, two groups belonging to the upper lid, a marginal and a more peripheral set.

In a Polish female, B—312, the tendo, for further comparison may be described as follows: It arose six millimeters from the naso-maxillary suture. It measured half a millimeter before giving off fibers from both margins, upper and lower. From the lower, the chief palpebral rings take origin for the lower lid, there being practically no fibers, as in the Japanese and the negro mentioned, arising from the maxillary bone below the ligamentum palpebrale mediale, and none from the ental aspect of the tendon slip. But the pars malaris ascending ectad to the tendon, carries its nerve filament upward with the angular vein, and the nerve ends in the small arc of reverting fibers from the upper edge of the short tendon. This was dissected upon the right side only.

In the left eye of a Cuban male, B—193, which was examined for such arrangements, there was no superior arcuate group, and therefore no reverting fibers. There was a brief, free lower margin to the tendon. Some fibers arose from the naso-frontal process of the maxilla, an important variation. No fibers arose from the ental aspect of the ligamentum, and there was therefore not so much indication of downfolding. At the distal termination of the ligamentum the fibers divided between the lids.

This Cuban, B—193, had a pronator whirl upon the left area of the vertex of the head. The hair suggested admixture of race, but was not crinkly, although the skin was of negroid coloring, and the ear was a small and negro form. The nasal bones may be compared with those of the bodies previously studied:

1.	Japanese:	(B—135)	middle transverse,	8.5 mm.
2.	Negro:	(B—274)	idem,	9.0 "
3.	Polish:	(B—312)	idem,	7.0 "
4.	Cuban:	(B—193)	idem,	7.0 "

(The negro, B—274, represents the type I call white hyaline, one whose articular hyaline surfaces on opening the joint appear blackish, or bluish white, as though containing pigment.)

Body 150, negro, female, about 40 years, color brown, on dissection showed in the muscles not the red tint sometimes seen, but a brownish yellow, and the fasciae were of the yellow, fatty character, also often noted in the negro of some types. The left radio-carpal articulation, when opened, disclosed hyaline coloration of the bluish-black-white tint seen in negroes of certain of the groups met with in dissecting, and not of the clear white, or the yellowish tints of certain of the mixed Europeans, or Slav groups. The tendo oculi attached close to the left naso-maxillary suture in the eye here studied. It was at a distance of from one to one and a half millimeter to the left of the suture when the tissues were exposed and the bone stripped of periosteum. On freshly opening the area, the tendo extended as a band (attached basally and continuously to the maxillary bone) towards the naso-maxillary suture, but the band dried out on standing and appeared farther from the suture instead of passing to it. The left eye only was dissected. The tendinous part of the canthal ligament was about 6 mm. in length, and, from the medial attachment to the canthal point, measured 11 millimeters after complete dissection.

On this body the nasal bone (left) measured 25 mm. from the left superior angle to the left inferior angle. A triangular element (5) apparently a part of the nasal bone was included in the measurement. This element could be seen at the lower left angle, but on drying did not show a distinct suture. Transverse measurement of the left nasal bone at halfway gave 8.5 millimeters.

Body 349, Hebrew, male, aged 73 years, compared, showed the muscular tint, on cleaning off fasciae, to be of a pale nature, the muscular fibers being fine, regular, not adherent by trabeculae to the overlying layers, as in the preceding illustration. The bony hyaline areas were pale yellow, and not of the blue-black or white-black color seen in negroes and some mixed European material.

The ligament in its tendinous portion was very short and, including all elements, it measured from its maxillary attachment to the canthal point about 10 millimeters. Its attachment to the maxillary bone was at 3.5 millimeters from the naso-maxillary suture, the left side being dissected. The left nasal bone measured 21 mm. in length from the left superior to the left inferior angle. It measured in transverse diameter, at halfway, 10 mm. It should be observed, also, that the tendo oculi was situated high, its upper margin lying at only two millimeters below the level of the left superior angle of the os nasale.

II. PARS ORBITALIS. DIAGONAL FIBERS OF UPPER LID. TWO STRATA AT THE LATERAL CANTHUS. TWO LAYERS OF BUCCAL PLATYSMA.

The orbicularis oculi muscle, usually assigned to the superficial stratum of the platysma group (Piersol, Human Anatomy), in the dissection of the Japanese here described, shows two definite strata. The platysma, itself, as dissected upon the neck, passing upwards over the margin of the mandible, has two strata easily seen in the dissection preserved. John M. Swan, discussing this occurrence in a subject in the laboratory of anatomy of the University of Pennsylvania some years ago, pointed out to me that this is a fairly frequent finding in some types.

We were using the routine negro and white material, and he said that this was due to morphologic causes. In this Japanese subject the two platysma strata pass upward and cross the "dead-line" drawn from the angle of the mouth to the ear-hole. (Piersol, in his lectures, used to state that this line is rarely crossed.) The layers of fascia as dissected here show stratification distinct from the two platysma layers, and can be held up to the light, exhibiting the contained muscle fibers.

At the lateral palpebral canthus, stratification of a curious form takes place. The lateral fasciculi, or bundles (Virchow, Kudo) (3), show a stratification, and a shifting of the two strata, with apparent dislocation as regards the relation of one to the other. The more superficial lying higher, we find a faint suggestion of double canthus. This ectal layer divided higher and more laterad with regard to the palpebral rima. It sent a descending set of fibers across the line of the rima to enter the pars ciliaris of the lower lid. Entad to these at the canthus lay muscle fibers from the deeper stratum, probably related to the slight ligamentum palpabrale laterale. These fibers combined to sweep medialward. Diagonal fibers in the upper lid may be described along its lateral portion. From the upper and ental level at the lateral canthus are fibers diagonally inserted along the upper palpebral margin, from the canthus medialward for twenty-three millimeters of the twenty-eight measured along the total margin of the upper lid. (The lid may have modified from the preserving fluid, but the proportions are probably correct.)

On the further medial margin there appeared no fibers at all of any muscular nature visible when dissected or afterward, the upper medial bundle sweeping higher by a short measurement and leaving the fascia and tarsal plate of the upper lid to occupy the palpebral margin. This gave a radiant effect to the upper lateral bundle. Such arrangements did not show in the other three dissections here first described.

Later dissection, upon the right eye of the same body (B—135. M—5), showed that the obliquely directed fibers of the fasciculus medialis of the upper lid were fewer in number, and very slender, except within three or four millimeters of the medial canthus. If it were not for the knowledge that slight muscular fibers often produce considerable effect, as in the dispersed sphincter fibers of the anus, and in the iris, and in the integumentary system, the possible effect of the more reduced bundles of muscle fibers on the right side might not be correctly estimated. Regular sweeping palpebral fibers were seen laterad to the obliquely placed fibers noted here in the dextral dissection. Attention is drawn at once to any fibers obliquely placed in the eyelid. The general problem of "mongoloid eye" and of "epicanthus" may be further studied.

III. NERVE SUPPLY OF THE ORBICULARIS OCULI

In the cat, the upper lid carries with it superior rami, the zygomatic from the dorsal ramus of the seventh nerve, which in this way supplies by a main branch the muscle bundles of the upper lid (Reighard and Jennings, page 376, 377) (13). Two dissections which I made recently appear to be regularly supplied in this way. In human (mixed European) material we find the rami temporales passing across the upper areas and distributing to the upper lid, and also supply from the superior zygomatic rami, which are less heavy, usually, than the inferior zygomatic rami. In the Japanese dissection, the corrugator was supplied by a nerve filament carried upward along the angular vein. In the cats and in the usual human arrangement, the corrugator is not so supplied, but from the superior zygomatic rami, which pass across the upper lid.

In the Polish and in the two negro dissections first compared in this paper, no filaments were transmitted upward from the inferior zygomatic nerve which was continued upward in the Japanese subject along the angular vein. But the rami temporales could not be followed, and the superior zygomatic rami did not attain the corrugator. In the Cuban dissected, the superior zygomatic rami passed as far as the middle of the upper lid, then breaking on account of extreme fineness.

IV. ANALYSIS OF THE PERIOPHTHALMIC FORAMINA

John M. Swan used to say in his teaching at the University of Pennsylvania, that these minute orifices are highly significant. In the Japanese head here reported, the inferior palpebral nerve issued by a separate canaliculus.

In the Polish head, female (B—312), a separate canaliculus for the left side provided for the transmissal of the same nerve, inferior palpebral. In the Cuban negro, and in the negro (B274) no separate channel existed.

Leaving the discussion to follow, arranged under the heads of tendon, muscle, nerve, and nasal variations, I may sum up the results of these dissections; and in presenting the material I wish to add an expression of my thanks to Professor Adam M. Miller for the opportunity, and to Miss Titus for her aid to us in the general indexing of laboratory materials. I must also thank Professor Tokuyasu Kudo for his interest and his comment upon my dissection of the Japanese, which I requested after making the dissection, on finding that he was in this country at the time. I would also thank Dr. John M. Swan for his advice years ago, in dissecting, that every point of attachment should be worked out in minute detail. Routine dissection of the tendon of the ocular sphincter does not always trace out the exact bony attachment, as should be done. Data of this character are difficult to obtain. Data bearing upon variations in nerve supply are equally scarce.

The possible variations of axis of the orbit may be indicated by the peripheral foramina about the orbital margin, as well as by muscular strata and nerve variations. The dislocation of strata in the palpebral musculature illustrate another plane of migration and of rotation.

The position of the rami zygomatici, as in the cat, rat, and races of man, also shows a tendency to shift in muscle planes.

SUMMARY

1. The tendon of the sphincter of the eye may arise from the intersutural membrane of the naso-maxillary suture.
2. The tendon may present a folding. The fibers of the orbicular muscle, then, do not arise from the inferior margin.
3. The raphé palpebralis lateralis may present two strata.
4. The relation of these variations may be a matter interesting to students of physical anthropology as well as to morphologists.
5. Association of study of the nasal bone with variation in the attachment of the tendon of the ocular sphincter will show that some relation to the changes in the apertura piriformis may exist.

V. THE SUPERFICIAL FASCIA OF THE FACE

In the dissection upon the Japanese subject the characteristic pad-like thickness and yellowish hue were noticeable. In the negro subjects there are the usual two forms, a thick, and a thin superficial fascia. But these, in the negro, are usually whitish and tough, not fatty. The fat lies deeper than the pannicle, although in some negroes, like the mixed Europeans, the fascia may be fatty and pale yellowish. With regard to the palpebral areas of the facial superficial fascia most observers agree that no fat invades the region of the ocular sphincter. This is true in the case of the one Japanese subject here recorded, although the toughness and density of the palpebral fascia resembled the pannicular characteristic of the negro. As the races of Japan are not clearly described today I may leave, for the present, the racial identification of this dissected subject. Baron Kikuchi, of Tokyo, in his History of Japan in collaboration with Brinkley gives some of the points of differentiation. Baelz is not followed today by some Japanese authorities, as I have reason to know.

VI. The embryology of the muscular elements derived from the hyoid is given by Keibel and Mall, and the work of Futamura (21) is quoted to show that originally two layers of the orbicular sphincter are present.

DISCUSSION

To the records of these dissections some comment may be added, as previous observers have been interested in the Mongoloid eye, and the racial characteristics have produced much discussion of note even before the paper by Kudo, in which the necessity of exact measurement of muscle bundles is emphasized, as in Hans Virchow's paper also.

J. Popofsky (6, 7, 8) gives the form of the fibers of the orbicular sphincter as found in the dissection of "un nègre Achanti". His drawing shows that the fasciculus superior lateralis (Kudo, Hans Virchow) sweeps, arching convexly upward, to join the continuity of the anterior auricular muscle. Although not stated in the text, this appears to create two levels of muscle at the lateral canthus.

Duchenne (9), discussing the musculature of the eye, says that the upper palpebral fibers are those of "reflexion" and "meditation." The development of the fasciculus, then, may be found, we might suspect, more complete in races of less vivacious temperament.

Richard Drews (10, 11, 12) considers the form of "falsches Mongolenaugen" and its occurrence in Bavaria and in other German areas, also methods of operation to relieve the appearance of "epicanthus". He notes that the offending fold contains tissue "attached to the sclera". He quotes Metschnikoff as follows: . . . "falsches Mongolenaugen. Es muss bemerken werden dass Augen, deren obere Lidfalte stark nach unten herabhängt und nur den oberen Wimpernrand verdeckt, ohne auf die innere Seite der Augen ueberzugehen, gar nicht als mongolenähnliche Augen bezeichnet werden können, eben weil das wichtigste Merkmal der letsteren in der halbmondförmigen Falte am inneren Augenwinkel besteht" (page 226, loc. cit.).

In the illustration of page 376, Reighard and Jennings (13) show two muscle planes at the left lateral canthus of a cat. Regarding my dissection upon the Japanese subject, M—5, here given, the level of the crossing lay higher than the canthus. But the fibers, in decussating, passed up or down, eventually, to enter the palpebral rings, and did not pass back from the face to attain the anterior auricular muscle, as in the Ashantee subject of Popofsky, or as in the cat.

Schauenburg (11) in 1862 stated that the occurrence of epicanthus (at inner palpebral angle) is endemic among the Eskimo.

Manz quoted by Drews (10) decides that the epicanthus is a "Missbildung". From this I should judge that work may still be done towards its study, especially with a view to secure measurements. Besides the actual epicanthus, we may measure the fibers in the lid which contribute to the heavy lidded upper muscle bundles. A study of two species of rat, one with orbit enclosed, one with orbit not enclosed, and comparison of the muscle fibers will show that the levator of the nose and lip occupies a position of direct continuity in the species of unenclosed orbit. Other rats show variations of continuity to the ocular sphincter, and to the tendo oculi.

Ranke (14) contributes to the study of epicanthus.

E. Regalia (15) in his paper "Dell'occhio mongolico" discusses the attachment point of the medial palpebral ligament, and finds ground for locating it at or at times inferior to the level of the dacryon. He says that a line drawn from the dacryon to the attachment of the lateral palpebral ligament will vary in its angle to the perpendicular. He says that Hyrtl (16) (17) (18) (1858) does not sufficiently specify the bony landmarks of the ligamenta palpebralia, and adds that he (Regalia) will undertake the study of these points upon cadavers. No record is available of his researches on this, but among the texts we have today there is considerable variation in the relations of the levator labi superioris alaeque nasi and the groups of ocular sphincters fibers at the medial attachment, and the exact attachments of the tendo oculi are not described as found, since wide racial variation of this tendon occurs. I may say that the tendo oculi may be found of several types:

- Long.
  - A. Fibers from both margins.
  - B. Fibers from lower margin.
  - C. Only canthal fibers.
  - D. Reverting fibers from superior margin.
- Moderate.
- Short.
  - A. Fibers from entire length of both margins.
  - B. Reverting fibers to pars malaris.
  - C. Almost of no length.
- Inferior palpebral rings arising from ental aspect of upper margin of the ligamentum.

The tendo oculi is described as attaching to the anterior lacrimal crest. As to this there is wide variation, if the extension along the maxilla counts for anything. But that the anterior lacrimal crest may not receive any attachment at times, I think can be shown, although fascia may be located here, for, as Swan used to say, there is always fascia between structures to call upon, and the "excelsior" or "packing" principle of William F. Campbell all his students will remember. We must discern definite strata of fibers before saying that the anterior lacrimal crest receives the medial palpebral ligament, and as to this the races widely differ.

In the new-born cat the definite fibers of tissue pass directly across the maxillary to meet the lip muscles, and this fibrous band I can show does not occur identical with the maxillary periosteum.

The level of the tendon is very variable. For purposes of comparison I shall take the following:

Length of a direct line from end of one tendon to that of the opposite side. (Through nose, by calipers.)

Length of a direct line from each to inter-nasal suture.

Length of tendon's insertion point to naso-maxillary suture.

Distance to angles of nasal bone.

These comparisons I shall add in a subsequent report with regard to racial dissections, and especially from other Sibiric material if I can obtain it, and I am hoping to receive from Professor Kudo some observations which he consented to make on his return to Ni-igata.

Regarding the nerves supplying the palpebral fasciculi, in the cat the temporo-facial nerves pass chiefly across the upper lid, and attain the nasal bundles of corrugator and piramidalis. In human races this is one chief variation: whether such are supplied from across the upper lid, or across the lower lid and by a nerve crossing the medial palpebral ligament.

The asymmetric nasal type of bone may render measurements for racial types difficult.

And, in addition to the factor of asymmetry, that of the variable infero-lateral angle of the nasal bone must be considered, when regarding the significance of any shift in attachment of the ligamentum palpebrale mediale. Here, as seen in the paper of W. L. H. Duckworth, (5) additional ossific processes may produce slight elements. These often are preserved only as markings upon the angle of the nasal bone. Daffner (19) in his study of the evolution of the face, remarks upon the early laying down of the nasal bones, which are clearly seen at the end of the third fetal month. He notes the fact that in the Hottentot the nasal bones may not appear at all, even in the adult. In the Polhemus collection of the Long Island College Hospital there is a skull (M—210) having "catarrhine" nasals, which presents also two distinct flaps or angulated processes overhanging the apertura piriformis of MacAlister.

These are even more remarkable than the ossicular elements of the Egyptian skull shown by Duckworth, and compared to the relations in the skull of a gorilla by him. Such variations, I believe, are closely connected with the point of attachment of the medial palpebral ligament and its variability. In the distance measured from the nasomaxillary suture there may be, if careful analysis can be effected, some relation to the pre-maxilla, as in my comparative studies upon the cat, rat and chicken, it seems to be true that muscles associated with the premaxilla are in direct continuity with the ocular sphincter, not only at early dates, but to some extent later.

LITERATURE

1. Piersol, (G. A.)—Human Anatomy. 4th ed., 8°, p. 484.
2. Virchow (Hans)—Gesichtsmuskeln. *Arch. Anat. & Physiol.*, Anat. Abth., 1908, 404.
3. Kudo (T.)—The facial musculature of the Japanese. *J. Morphol.*, 1919, XXXII, 659.
4. Anatomy. *The Med. Epitome Ser.*, N. Y., 1903, 164.
5. Duckworth (W. L. H.)—Nasal Bone. *J. Anat.*, 1901–3, 257.
6. Popofsky—*L'Anthrop.*, 1890, No. 1.
7. (quot. by Popofsky)—Dissection of a Bushwoman. *J. Anat.*, 1867.
8. (quot. by Popofsky)—Die vorn Facialis innervirten Muskeln des Halses, Nacken und des Schaedels (gorilla). *Morphol. Jahrb.*, 1887, 49.
9. Duchenne.—Méchanisme de la physiognomie humaine, etc., Paris, 1876.
10. Drews (R.)—Neben das Mongolenaugen. *Arch. f. Anthrop.*, 1888–9, No. 18.
11. (quot. by Drews)—Schauenburg, in *Opthalmiatric*, 1862, 14.
12. (quot. by Drews)—Ueber die Beschaffenheit der Augenlider bei den Mongolen und Kaukasiern. *Z. f. Ethnol.*, 1874, VI, 153–160.
13. Reighard and Jennings. Anatomy of the Cat. 2nd ed.
14. Ranke (J.)—*Corrbl. Ges. Anthrop.*, 1888, No. 10.
15. Regalia (E.)—Dell'occhio mongolico. *Arch. f. Antrop. & Etnol.*, 1888.
16. Hyrtl (J.)—Manuele di Anatomia. (Ital.) 1858.
17. Harmon.—On eylids (in Fishes). *J. Anat. & Physiol.*, 1899, XXXIV.
18. Beraneck (E.)—L'oeil primitif des Vertêbrées. *Arch. Sci. Phys. & Nat.*, 1890, XXIV.
19. Daffner (F.)—Nasenbein (Evolution of the Face). *Arch. f. Anthrop.*, 1900–2, 342.
20. Futarura (cited in Keibel & Mall).

Additional literature and quotations of some relation to this article.

Knowles (F. H. S.)—Interorbital width. *J. Anthrop. Inst.*, 1911, XLI.

Russell (F.)—Laboratory course in Somatology. *Am. Anthrop.*, 1901.

Gregory (Wm. K.)—Orders of Mammals. 1910, 424 (overlapping of nasal bones).

"Polizoisme"—La femme a deux nez. *Bull. Soc. d'Anthrop.*, Paris, 1900–1, 333.

Sergi (S.)—Die mimischen Gesichtsmuskeln (einer Mikrokephalen). *Arch. f. Anthrop.*, 1913–14..

Pritchard and Siebold (quot.)—Mongolian Eye. *Natur-geschichte*, 1845.

Hyrtl (J.)—Manuele di Anatomia, 1858, 102. Quoted by Regalia, page 152, *Arch. l'antrop. & la etnol.*, 1888.

"Ineguaglianza e scabrosità di superficie che trovasi mancante solo in pochi crani, è proprio delle ossa, apofisi frontale del zigomatici, apofisi nasale del mascellare superiore, nei punti dove hanno lor presa ed attaco i ligamenti angolari dell'occhio."

Regalia—

"Come è facile immaginare a me avrebbe fatto un grandissimo comodo il poter determinare il punto dove è inserita la porzione dirretta del tendine dell'orbiculare;

ma io non sono riuscito a trovare nelle apofisi ascendente dell'ineguaglianze e scabrosità di superficie."

Regalia—

"La porzione del canal lagrimale appurtenente all'unguis si restringe tanto superiormente da rendere probabile che fossero piu di solito inferiori al Dacryon la sommito del sacco lagrimale, il tendine dell'orbiculare e l'angolo dell'occhio."

Metschnikoff (E.)—De la configuration des paupierès chez les Mongols et les peuples d'origine caucasique. *Rev. d'anthrop.*, 1875, 174.

Ten Kate (H.)—American Indian strains in Japanese. *Int. Cbl. Anthrop.*, Stettin, 1902. This paper also states the fact that the respiratory and the olfactory areas of the Japanese are different, and we may conclude that this is associated with the maxillo-nasal conformation. Ten Kate speaks of some "anosmia."

Papillault—Genèse et connexions de quelques muscles de la mimique. *Rev. école d'anthrop.*, 1902. Quotes Darwin's law: Facial expression may result by the association of useful habits after their function has ceased. Papillault adds that this is supported by anatomic facts. Dissections of two anthropoids add to the value of the paper (Facial muscles of Hylobates leuciscus and H. leucogemys).

In *L'Anthropologie*, 1905, 445–456, a negro is described the muscles showing red on dissection. Death had been due to sleeping sickness. Muscles of the face often vary within a certain range from reddish to pale pink.

Vram—Metodo per determinare l'inclinazione dell'orbita. *Atti Soc. Rom. antrop.*, 1906. (Useful for tendon line.)

Baelz—Neben die Menschenrassen Ostasiens mit spezieller Ruecksicht auf Japan. *Verh. Berl. Ges. Anthrop.*, 1902, 166–189.

Birkner—Beitraege zur Rassenanatomie der Chinesen. (Six chinese heads studied.) *Corrbl. Ges. Anthrop.*, 1904, 144–148.

Whitnall—Anatomy of the Human Orbit. London, p. 148: (tendo oculi) inferiorly is thicker and terminates in a free margin, which is prominent owing to the generally oblique position of the ligament from above downwards and forwards, and is conspicuous since it is bare of muscle fibers.

Bailey and Miller (and Strong)—Text-Book of Embryology. Regarding the nerve fibers, (page 434); the branchial efferent portions consist simply of one neurone proceeding all the way from the nerve tube to the muscle innervated, thus resembling the somatic rather than the visceral nerves of the head.

Mann (R.)—Facial Expression. *Intern. Quart.*, 1905.

Chaillon—Considerations générales sur quatre types morphologiques humaines. *Bull. & Mem. Soc. Anthrop.*, Paris, 1910.

ANTHROPOMETRIC OBSERVATIONS ON THE CHOCTAW[1]

HENRY B. COLLINS, Jr.

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The Choctaw present one of the most striking examples to be found in North America of an Indian tribe once large in numbers, and of first importance historically and ethnologically, which has failed as yet to receive due attention by anthropologists. The physical type of the present population has not been studied and the skeletal material collected from the region formerly occupied by the Choctaw is scanty and of no great value. This latter is due in large part to climatic conditions in the South, which are unfavorable to the preservation of skeletal remains, but also because generally the crania are artificially deformed, making it impossible to arrive at an exact determination of the original head form.

According to Dr. Hrdlička,[2] the aboriginal population of the southeastern states was composed of two more or less distinct elements. One of these, as represented by the Natchez, Alabama, and possibly Choctaw, with other smaller tribes, was strongly brachycephalic with a high head. This type was confined to the region extending from Florida and Georgia westward to Arkansas and Louisiana, including parts of Tennessee. The other strain, including the Creeks, Chickasaws, and Seminoles, was more oblong-headed but still rather high vaulted. This second type is found with varying frequency thruout the same region as that occupied by the brachycephalic group, but its affiliations are to the north, representing probably the southward extension of an originally dolicho- to mesocephalic element, which by intermixture with the southern tribes underwent a gradual broadening and heightening of the head. The Choctaw as the largest tribe in the Gulf region and as perhaps a basic type culturally and physically, thus assume considerable importance in any consideration of the ethnic problems of this area.

While engaged in an investigation on the prehistoric mounds and village sites of eastern Mississippi for the Bureau of American Ethnology during the past summer, I was afforded an opportunity to secure measurements and observations on some of the Choctaw in the vicinity of Philadelphia, Miss. I wish to express my thanks to Mr. H. H. Knoblock who, representing the Mississippi Department of Archives and History, accompanied me on the trip, and to Mr. T. M. Scott of the Indian agency at Philadelphia, whose intimate knowledge of the Choctaws was placed at our disposal.

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[1] Published with the permission of the Bureau of American Ethnology, Smithsonian Institution.

[2] The Anthropology of Florida. Small 4°, Fla. S. Hist. Soc., Deland, Fla., 1922.

There are still at the present time some 1000 Choctaws in Mississippi, most of them in the counties of Neshoba, Kemper, Leake, and Newton. Measurements were taken on 58 adults, 40 males and 18 females, from which series 7 males and 1 female were later removed because of the probability of mixed blood, so that the following data relate to 33 males and 17 females. A considerable number of the tribe are undoubtedly mixed with whites and negroes, but very little miscegenation has taken place in recent years.

The anthropometrical method employed was that outlined by Dr. Hrdlička,[3] by whom I have also received direct training. The instruments used were the Hrdlička spreading compass, the small Broca sliding compass, and the anthropometric tape. The large sliding compass for taking the chest diameters was not available, so the chest measurements had to be omitted. Twenty-eight of the subjects were examined at the Indian Agency in Philadelphia, Miss. The exact weights of these subjects were obtained. With the others it was necessary to go to their homes, and in these cases the weights are only approximations.

DESCRIPTIVE NOTES

Skin Color. Subjects were examined on the chest for skin color, which was noticeably lighter there than where the skin had been exposed to the sun. Broca's color standards, as published by Hrdlička (Part R., Bull. 39, U. S. Nat. Mus.), were used. The majority of both sexes were found to be of a tan color, ranging between Nos. 24, 25, and 26, with a few individuals of darker brown hue. The males generally were somewhat darker than the females.

Hair. In all of the 50 individuals here considered the hair was thick, coarse, black and straight. Gray hair was observed in Nos. 7, 26, 41, 51, and 52, which small group included most of the older subjects. Among the eight individuals whose measurements were excluded because of the probability of mixture, the hair showed a more or less distinct waviness as well as a perceptible thinning in those above 40 years of age.

Eyes. The eyes were in every case a dark brown.

Mustache and Beard. Facial hair was scanty, the usual condition in

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[3] Anthropometry. 8°, Wistar Inst. of Anat. & Biol., Philadelphia, 1920.

No. 39

No. 24

No. 48

No. 1

Choctaw Types

the males being a very scattered growth, principally on the chin and upper lip.

Head. In two individuals there was a slight sagittal ridge, and in one case (No. 51) asymetry, produced by an undue bulging of the parietal and occipital regions. Occipital flattening was observed in two instances; the head measurements of these are given but are not included in the averages.

Forehead. The forehead for the males was recorded as fairly high in 34 per cent; medium in 48 per cent, and low in 18 per cent. Of the females, 41 per cent had fairly high foreheads, 35 per cent medium, and 23 per cent low. The average forehead in the females was not only proportionally higher than that of the males, but the measurements show it to be on the average actually higher by 8 mm. This condition[4] should probably be attributed to a higher hair line in the females, which results in a higher and more rounded forehead. Among the males 63 per cent had upright foreheads, 33 per cent showed a slight backward slope and 4 per cent a moderate slope; while in the females 76 per cent showed no slope and 24 per cent only a slight slope.

Supraorbital Ridges. The development of the supraorbital ridges was not especially pronounced in either sex. The conditions were as follows:

	Males		Females	
	Number	Per cent	Number	Per cent
Slight	6	18	16	94
Moderate	8	24	1	6
Medium	11	33		
Pronounced	8	24		

Eye Slits. The slant of the eyes was found in general to be but slightly more pronounced than in whites. Only two individuals, both males, showed any marked evidence of epicanthus.

Malars. The malars of both sexes were found to be constantly more prominent than in whites, but not to such a degree as is found among some other Indian tribes.

Nasion Depression. This feature was distributed as follows:

	Males		Females	
	Number	Per cent	Number	Per cent
Shallow	7	21	7	41
Medium	17	51	9	53
Deep	9	27	1	6

Nose. The shape of the nose was recorded most frequently as straight, slightly concave or slightly convex:

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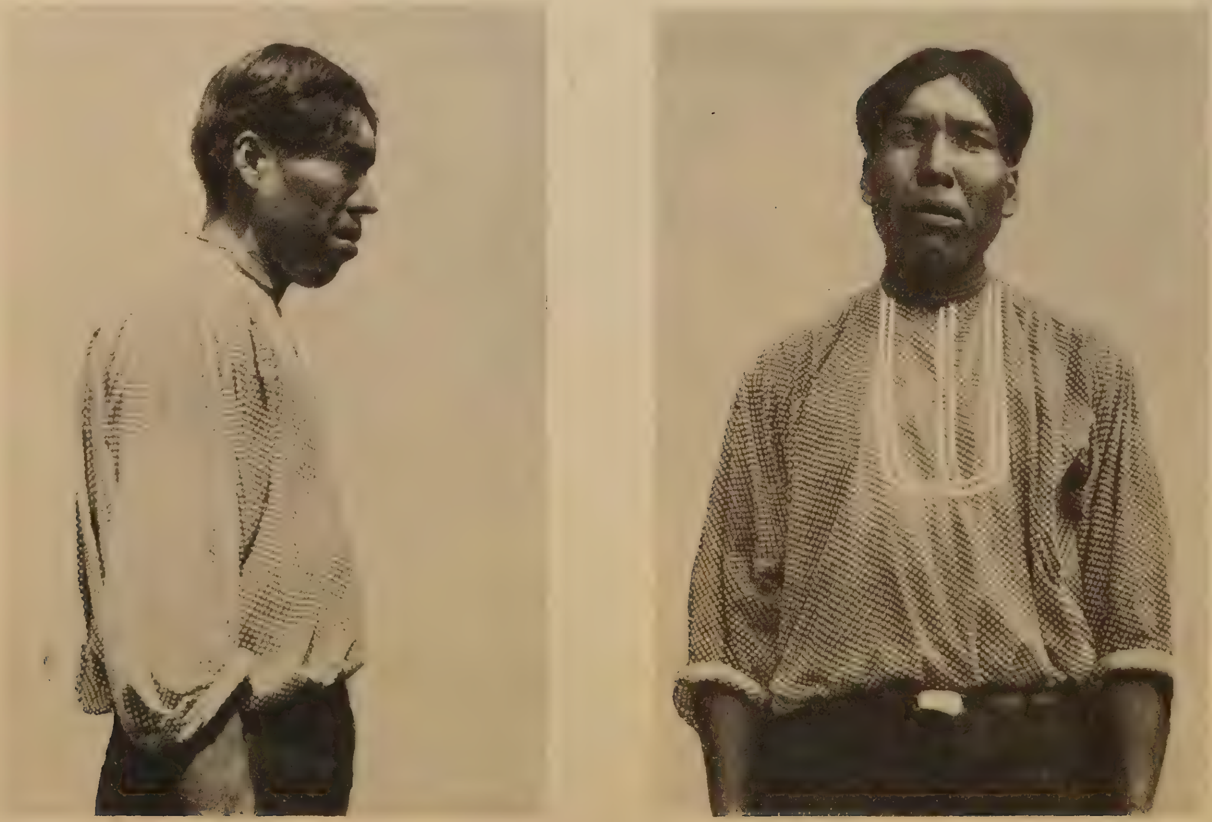
[4] Found by Hrdlička also among the Old Americans (8°, 1925, Waverley Press, Baltimore).



No. 53

No. 53

Choctaw Types

	Males		Females	
	Number	Per cent	Number	Per cent
Concave	2	6	—	—
Slightly Concave	5	15	2	12
Straight	15	45	10	59
Slightly Convex	8	24	2	12
Convex	3	9	3	17

Nasal Septum. The nasal septum was found to incline mildly upward in 24 per cent of the males and 23 per cent of the females. It was horizontal or nearly so in 64 per cent of the males and 71 per cent of the females, and showed a downward inclination in 12 per cent of the males and 6 per cent of the females. Most of the latter type were found, as usual, among the older subjects.

Lips. As in most Indians the lips were found on the whole to be somewhat fuller than in whites. The conditions were as follows:

	Males		Females	
	Number	Per cent	Number	Per cent
Thin	1	3	—	—
Medium	16	48	12	70
Above Medium	16	48	5	29

Alveolar Prognathism. There was but little alveolar prognathism observed. The females showed a somewhat greater tendency in this direction than did the males.

Chin. The chin was recorded as to prominence and form, with the following results:

Prominence

	Males		Females	
	Number	Per cent	Number	Per cent
Submedium	5	15	6	35
Medium	24	73	9	52
Above Medium	4	12	2	12

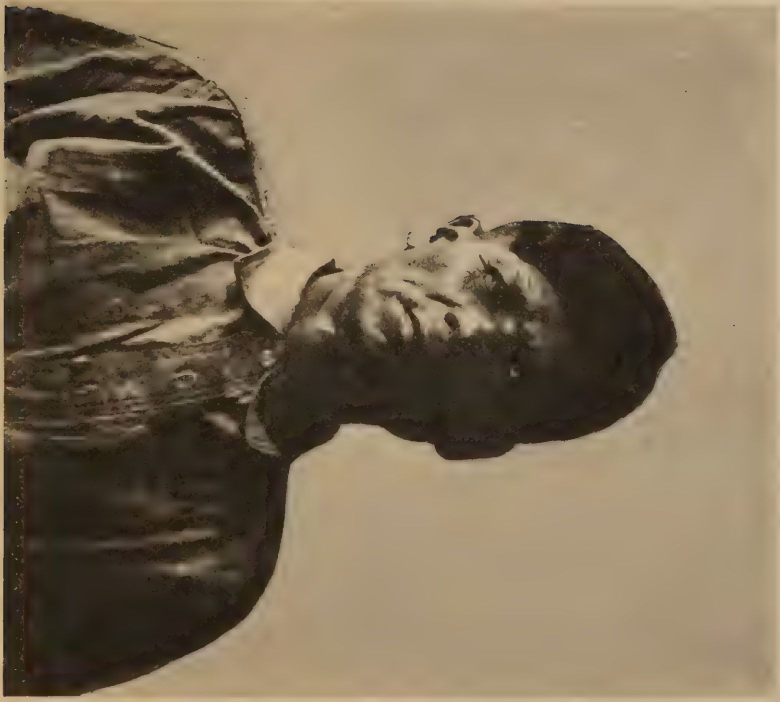
Form

	Males		Females	
	Number	Per cent	Number	Per cent
Ordinary	28	85	7	41
Pointed	1	3	10	59
Square	4	12	—	—

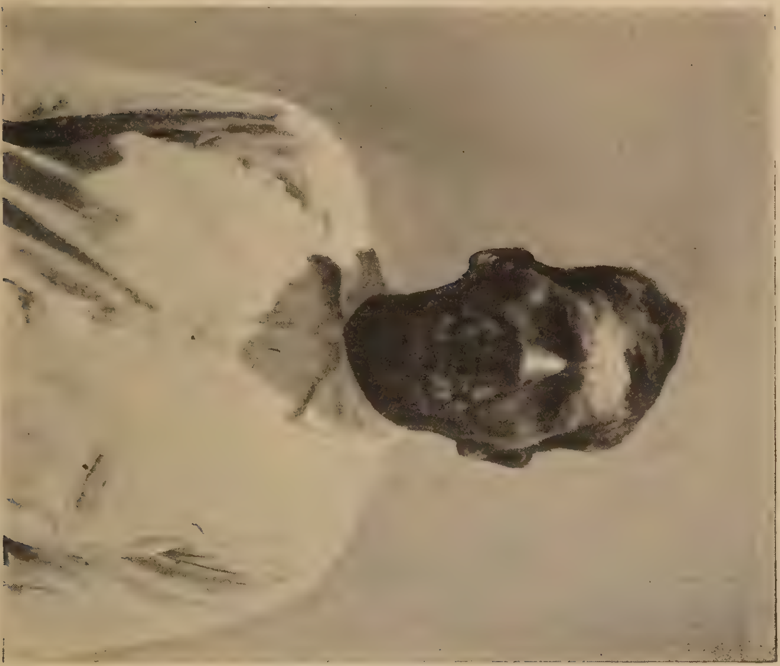
Body and Limbs. Observations on the body and limbs were as follows:

	Males		Females	
	Number	Per cent	Number	Per cent
Spare	4	12	4	24
Medium	21	64	8	47
Muscular	8	24	Plump 5	29

Health. The subjects examined were mostly in good health. A few suffered from malaria, and two (Nos. 45 and 57) had incipient tuberculosis. The latter disease is rather prevalent among the Mississippi Choctaws.



No. 41



No. 51

MEASUREMENTS

The group is shown to be of rather high stature. The only measurements directly available for comparison are those made by students of Dr. Boas at the Chicago Exposition in 1893, who give the stature of 260 Chotaws as 170 cm. for males and 157.2 cm. for females. Our stature averaged for the males 171.4 cm. and for the females 156.2. The difference in stature between male and female in the present series is unusually large, being 15.2 cm. as compared with the usual difference of about 12 cm. Hrdlička, in his study on "Stature among the Indians of the Southwest and of northern Mexicco,"[5] found this difference to range from 9 cm. in the Walapai to 15.4 cm. in the Yaqui.

As to head form the subjects here considered do not conform very closely to the brachycephalic Gulf type. The average cephalic index of 78.8 for males and 80.1 for females is closer, in fact, to that of the longer headed element before mentioned, which is found in burial mounds together with the broad-headed type in different localities of the Gulf region. As to the mean height index, measurements of head height on the living and on the skull are not directly comparable, the former being smaller on the average by some 9 mm., which means a corresponding lowering of the mean height index by about 5 points. Converted in this way, the mean height index of the present series, 80.4 for males and 80.7 for females on the living, or approximately 85.4 for the males and 85.7 for the females on the skulls, would be in fair agreement with the index given by Hrdlička on the Florida crania (86.0 for males and 88.1 for females), in which were represented both the brachycephalic and mesocephalic types. The reverse is true, however, as regards the cephalic index. This index is generally greater by about 2 points on the living than on the skull, so that if the measurements of the Mississippi Choctaws were reduced to those of the skull, the majority would be still further removed from the broad-headed type.

If the original Choctaw type was strongly brachycephalic, should the lowered cephalic index found in the present population be attributed to an infiltration of other blood? It is quite certain that there are still in our series individuals with traces of white, which might in some degree account for the altered condition. On the other hand it is very unlikely that the Choctaws of even a century or two ago were a homogeneous group. The population of the tribe around 1700 is variously estimated to have been from 15,000 to 20,000. The territory occupied included the southern half of the present state of Mississippi with parts

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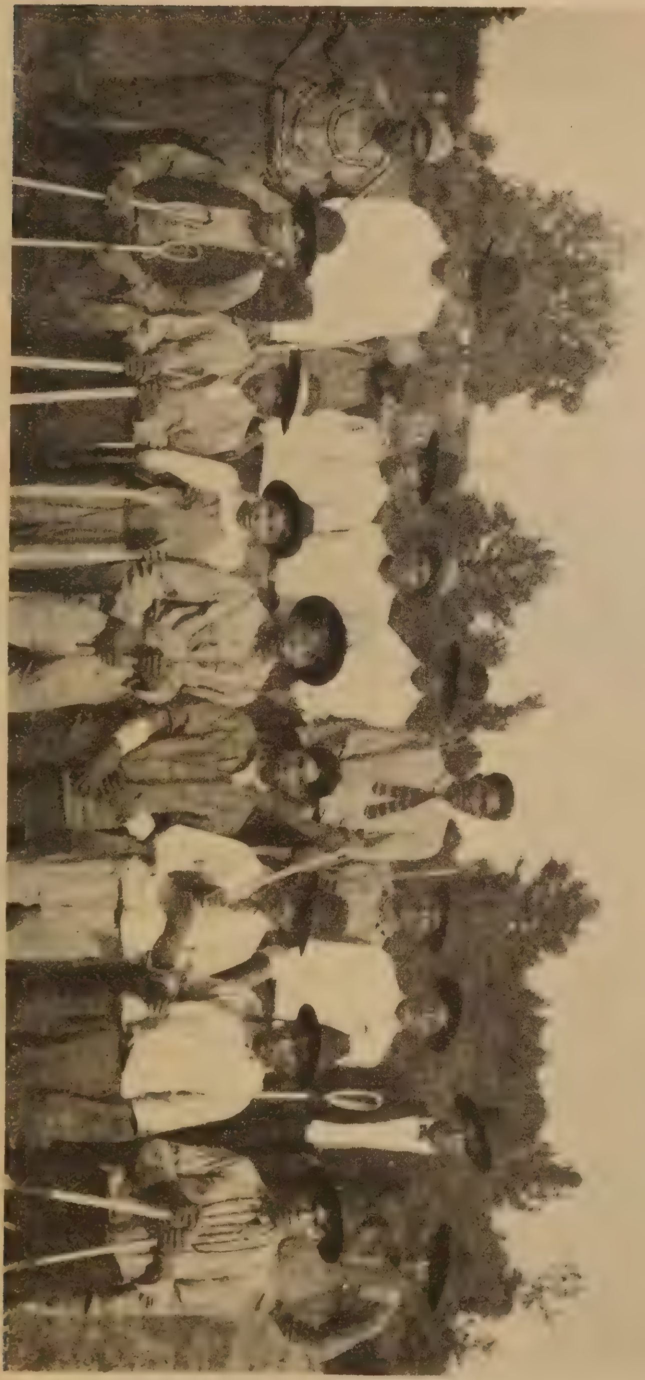
[5] Putnam Anniv. Vol., Small 4°, 1909, 405–426.



Group of Choctaw Indians assembled for a game of native ball at Philadelphia, Miss., July 1925

TABLE 1. CHOCTAW
(Arranged by the

No.	Approx. age	Deformation of head	Height	Max. finger-reach	Excess of finger-reach over height	Sitting height	Sitting height, per cent of total height	Head: d. ant. post.	D. lateral max.	Cephalic Index	Height line bet. aud-meati to bregma	Cephalic Module	Mean height Index	Face: Menton-nasion.	Menton-crinion	Height of forehead (nasion-crinion)
32[1]	29		183.4	190.8	7.4	93.0	50.7	20.4	14.8	72.5	14.2	16.46	80.7	11.7	17.4	5.7
51	67		172.5	182.3	9.8	88.2	51.1	19.9	14.7	73.9	14.1	16.23	81.5	12.6	18.5	5.9
1	24		167.0	179.5	12.5	93.5	56.0	20.0	14.8	74.0	14.3	16.36	82.2	12.2	19.0	6.8
53	32		182.6	189.5	6.9	96.0	52.6	20.8	15.7	75.5	14.5	17.00	79.5	14.6	21.4	6.8
34	37		180.5	190.7	10.2	96.1	53.2	19.5	14.8	75.9	13.1	15.80	76.4	12.6	19.2	6.6
26	50		167.0	171.4	4.4	87.7	52.5	19.1	14.5	75.9	13.7	15.76	81.5	12.4	19.2	6.8
50	27		165.9	172.3	6.4	88.1	53.1	20.0	15.2	76.0	14.6	16.60	83.9	12.4	18.5	6.1
48	26		167.2	172.0	4.8	89.0	53.2	19.4	14.8	76.3	13.5	15.93	78.9	12.5	19.5	7.0
47	23		174.0	182.4	8.4	89.6	52.7	19.1	14.7	77.0	13.8	15.86	81.7	12.8	19.4	6.6
38	38		168.2	171.1	2.9	87.7	52.1	19.3	14.9	77.2	13.4	15.86	78.4	12.9	19.4	7.0
16	25		175.5	181.5	6.0	92.0	52.4	18.9	14.6	77.2	14.0	15.83	83.6	12.2	17.2	5.0
58	25		169.3	175.8	6.5	89.5	52.9	20.1	15.7	78.1	14.2	16.66	79.3	12.3	18.6	6.3
45[1]	23		187.0	199.3	12.3	93.0	49.7	20.2	15.8	78.2	14.4	16.80	80.0	12.4	18.3	5.9
15	30		170.5	177.0	6.5	88.5	51.9	19.3	15.1	78.2	14.2	16.20	82.6	12.3	19.3	7.0
46[1]	21		179.4	191.9	12.5	89.8	50.1	19.8	15.5	78.3	13.8	16.36	78.2	12.3	18.3	6.0
28	29		174.0	184.7	10.7	88.2	50.7	18.8	14.8	78.7	13.0	15.53	77.4	12.7	18.0	5.3
22	25		162.3	169.3	7.0	83.2	51.3	18.1	14.4	79.6	13.5	15.33	83.1	11.6	16.8	5.2
55	35		173.3	171.4	1.9	91.8	53.0	19.2	15.3	79.7	14.0	16.16	81.2	12.2	19.4	7.2
6	41		168.5	176.3	8.0	88.0	52.2	19.1	15.4	80.1	13.9	16.13	80.6	11.6	18.8	7.2
3	27		181.0	187.1	6.1	93.5	51.7	19.1	15.3	80.1	13.8	16.06	80.0	12.4	18.0	5.6
43	20		167.9	171.3	3.1	91.2	54.3	18.8	15.1	80.3	13.6	15.83	80.2	10.9	19.0	8.1
27	26		165.3	169.6	4.3	88.1	53.3	19.8	15.9	80.3	14.2	16.63	79.6	12.4	19.5	7.1
7	62	sl. occ. fl.	171.0	179.6	8.6	90.0	52.6	(19.2)	(15.5)	(80.7)	(13.6)	16.10	(78.4)	12.5	19.2	6.7
42	23		163.7	170.3	6.6	87.9	53.7	18.1	14.7	81.2	13.5	15.43	82.3	11.4	17.8	6.4
18	50		168.1	169.3	1.2	87.0	51.8	18.7	15.2	81.3	13.4	15.76	79.1	11.3	16.9	5.6
49	35		161.0	168.4	7.4	85.6	53.2	18.9	15.4	81.5	13.4	15.90	78.1	12.6	19.5	6.9
57	43		171.8	177.6	5.8	88.0	51.2	18.5	15.1	81.6	13.7	15.76	81.5	12.1	18.0	5.9
23	30		167.0	174.6	7.6	87.8	52.6	18.7	15.3	81.8	13.9	15.96	81.8	11.3	18.0	6.7
40	26		174.7	181.8	7.1	89.2	51.1	18.2	14.9	81.9	13.2	15.43	79.8	12.5	18.5	6.0
35[2]	19		166.0	175.3	9.3	86.0	51.8	18.9	15.7	83.1	14.5	16.36	83.8	13.2	18.8	5.6
2	17		177.0	183.5	6.5	90.0	50.8	18.7	15.8	84.5	13.7	16.06	79.4	12.0	18.9	6.9
41	54		165.7	170.8	5.1	88.7	52.5	17.9	15.3	85.5	13.5	15.56	81.3	11.2	16.9	5.7
37	23	mod. occ. fl.	167.5	173.3	5.8	86.7	51.7	(17.6)	(15.4)	(87.5)	(13.3)	15.43	(80.6)	11.1	17.5	6.4
Averages			*171.4*	*178.2*	*6.8*	*89.5*	*52.2*	*19.20*	*15.13*	*78.8*	*13.8*	*16.04*	*80.4*	*12.23*	*18.58*	*6.35*
Minima			161.0	168.4	1.2	83.2	49.7	17.9	14.4	72.5	13.0	15.33	76.4	10.9	16.8	5.0
Maxima			187.0	199.3	12.5	96.1	56.0	20.8	15.9	85.5	14.6	17.00	83.9	14.6	21.4	8.1

[1] Sons of 51 and 52.

[2] Feeble minded, hereditary.

TABLE 2. CHOCTAW

No.	Approx. age	Deformation of head	Height	Max. finger-reach	Excess of finger-reach over height	Sitting height	Sitting height per cent. of total height	Head: d. ant. post.	D. lateral Max	Cephalic Index	Height line bet. aud-meati to bregma	Cephalic Module	Mean height index	Face: Menton-nasion	Menton-crinion	Height of forehead (nasion-crinion)
19	48		159.6	164.5	4.9	82.2	51.6	19.9	14.6	73.4	14.0	16.16	81.2	11.5	17.8	6.3
31	35		155.0	163.4	8.4	78.8	50.8	18.4	14.0	76.1	13.4	15.26	82.1	11.0	17.2	6.2
10	24		152.5	157.0	4.5	81.5	53.4	18.3	14.3	78.1	13.1	15.23	80.4	11.1	17.0	5.9
21[3]	46		152.6	155.0	2.4	82.5	54,4	18.3	14.4	78.7	13.2	15.23	80.7	11.6	18.0	6.4
17	38		158.5	160.2	1.7	82.2	51.9	18.5	14.6	78.9	13.0	15.36	78.5	11.4	17.9	6.5
20[2]	21		147.0	150.5	3.5	79.0	53.7	18.3	14.5	79.2	13.3	15.36	81.1	11.7	17.7	6.0
52	58		173.4	183.5	10.1	87.4	50.4	18.9	15.0	79.4	13.5	15.80	79.6	10.7	16.6	5.9
36	21		155.0	158.6	3.6	82.2	53.0	18.1	14.4	79.6	13.1	15.20	80.6	11.4	17.8	6.4
39	35		156.8	159.0	2.2	83.3	53.2	17.8	14.2	79.8	12.8	14.93	80.0	11.4	17.6	6.2
33	26		149.9	153.3	3.4	79.6	53.1	18.4	14.7	79.9	13.2	15.43	79.8	11.2	18.0	6.8
44	25		152.7	166.6	13.9	82.3	53.9	18.6	14.9	80.1	13.5	15.66	80.6	11.5	18.3	6.8
11	20		157.5	164.0	6.5	83.5	53.0	18.4	15.0	81.5	13.2	15.53	79.1	11.7	18.6	6.9
24	35		154.6	159.6	5.0	82.5	53.4	17.1	14.1	82.5	12.7	14.63	81.4	11.9	17.9	6.0
29	23		160.6	167.2	6.6	82.9	51.6	18.3	15.2	83.1	13.7	15.73	81.8	11.0	18.2	7.2
13	35		160.0	168.0	8.0	85.0	53.1	17.9	15.1	84.4	13.8	15.60	83.6	11.3	18.0	6.7
9[1]	48		154.0	156.5	2.5	81.0	52.6	16.8	14.0	84.5	12.3	14.36	79.9	11.0	18.4	7.4
14	29		156.0	166.5	10.5	77.0	49.5	17.0	14.5	85.3	12.9	14.76	81.9	12.0	17.6	5.6
Averages			*156.2*	*161.9*	*5.7*	*82.0*	*52.5*	*18.17*	*14.55*	*80.1*	*13.2*	*15.31*	*80.7*	*11.37*	*17.80*	*6.43*
Minima			147.0	150.5	1.7	77.0	49.5	16.8	14.0	73.4	12.3	14.36	78.5	10.7	16.6	5.6
Maxima			173.4	183.5	13.9	87.4	54.4	19.9	15.2	85.3	14.0	16.16	83.6	12.0	18.6	7.4

[1] Mother of 10 and 11.

[2] Daughter of 19.

[3] Mother of 43 and 47 (Table 1).

MALES.
Cephalic Index)

Diam. bizygom max.	Nose: height to nasion	Nose, width max.	Nasal index	Mouth, width	Left ear, length	Left ear, width	Ear index	Left hand, length	Left hand, width	Hand index	Left foot, length	Left foot, width	Foot index	Left leg circum. max.	Weight
14.6	5.0	4.0	80.0	5.5	6.2	3.5	56.5	20.6	10.3	50.0	29.8	11.0	36.9	52.0	175.
14.2	5.6	4.3	76.8	5.0	6.7	4.1	61.2	19.4	9.5	49.0	27.3	10.0	36.6	45.5	(145.)
14.3	5.6	3.9	69.6	5.6	6.7	3.6	53.7	17.9	10.0	55.9	26.0	10.3	39.6	55.0	165.
15.7	6.1	4.0	65.6	5.6	6.9	3.7	53.6	19.7	10.1	51.3	29.0	11.5	39.7	57.0	184.5
14.9	5.4	4.4	81.5	6.0	6.2	3.4	54.8	19.3	9.3	48.2	26.2	11.5	43.9	53.0	(165.)
15.1	5.2	4.6	88.5	6.1	6.8	3.5	51.5	18.1	8.9	49.2	25.8	9.6	37.2	50.0	(160.)
14.0	4.7	3.9	83.0	5.1	5.7	3.1	54.4	17.5	8.5	48.6	24.8	10.3	41.5	49.5	145.
14.4	5.3	4.1	77.4	5.2	5.9	3.4	57.6	17.9	8.8	49.2	26.2	10.9	41.9	51.0	138.5
14.4	5.0	4.0	80.0	5.2	6.3	3.3	52.4	17.7	9.0	50.8	26.0	10.2	39.2	55.0	146.
13.8	5.2	4.1	78.9	5.6	6.3	3.4	54.0	18.0	8.6	47.8	25.3	10.1	40.0	50.5	(145.)
14.1	5.2	4.1	78.8	5.3	6.1	3.1	50.8	19.1	9.0	47.1	27.5	9.7	38.0	51.0	147.5
14.8	5.1	3.6	70.6	5.4	6.3	3.6	57.1	18.5	9.0	48.6	25.8	10.0	38.8	52.0	153.
14.1	5.5	4.2	76.4	5.7	6.0	3.8	63.3	20.5	10.0	48.8	29.8	11.0	36.9	53.5	167.
14.3	5.3	3.9	73.6	5.6	5.9	3.1	52.6	17.8	9.0	50.6	25.5	10.5	41.2	47.5	138.
14.5	5.7	4.2	73.7	4.9	6.0	3.4	56.7	20.6	9.2	44.7	28.7	10.0	34.8	53.0	147.
14.0	5.1	4.3	84.3	5.5	6.5	3.4	52.3	18.9	9.4	49.7	26.7	10.1	37.8	55.0	(175.)
14.0	4.6	3.5	76.1	5.1	5.9	2.8	47.5	17.9	8.4	46.9	24.2	9.0	37.2	50.0	117.
14.3	4.1	4.2	82.4	5.7	6.2	3.5	56.5	18.1	9.4	51.9	26.5	10.9	41.1	56.0	147.
14.8	4.7	3.8	80.9	5.5	6.5	3.8	58.5	17.6	8.6	48.9	25.5	10.0	39.2	48.5	140.
14.9	4.9	3.9	79.6	5.4	6.6	3.4	51.5	18.8	9.5	50.9	27.0	11.2	41.5	58.0	199.
14.7	5.3	3.8	71.7	5.3	6.3	3.3	52.4	17.7	8.8	49.7	25.3	10.7	42.3	52.5	141.
15.0	5.2	3.5	67.3	4.9	6.8	3.2	47.1	17.8	8.5	47.8	25.6	10.5	41.0	50.0	142.
13.9	5.3	3.8	71.7	5.8	6.5	3.3	50.8	17.9	8.7	48.6	27.5	11.0	40.0	51.0	(140.)
14.0	4.7	4.1	87.2	5.2	5.4	3.2	59.3	18.0	8.8	48.9	25.2	9.3	36.9	52.5	130.
14.8	5.3	4.5	84.9	5.9	6.8	3.5	51.5	17.9	8.9	49.7	25.5	10.7	42.0	49.5	152.
14.9	5.6	4.0	74.1	5.9	5.7	3.2	56.1	18.3	9.1	49.7	24.8	10.6	42.7	54.0	141.5
13.8	5.1	3.8	74.5	5.2	5.9	3.1	52.5	18.9	8.3	43.9	26.0	10.0	38.5	49.0	130.5
14.2	4.9	3.6	73.5	5.6	5.5	2.9	52.7	18.0	9.1	50.6	25.6	10.7	41.8	52.0	160.5
13.9	5.1	3.4	66.7	5.1	5.7	3.1	54.4	18.0	9.3	51.7	24.3	10.4	42.8	54.0	148.5
14.6	5.2	4.2	80.8	5.6	6.0	3.9	65.0	18.9	8.5	45.0	27.0	10.3	38.1	48.5	(130.)
14.0	5.4	3.8	70.4	5.1	5.9	3.5	59.3	18.7	8.9	47.6	27.5	9.8	35.6	52.0	147.
14.3	5.0	3.8	76.0	5.3	5.9	2.9	49.2	17.9	9.2	51.4	24.8	9.1	36.7	48.0	127.
14.3	5.3	3.8	71.7	5.0	5.9	3.5	59.3	18.2	8.5	46.7	26.2	9.6	36.6	50.0	(140.)
14.41	*5.2*	*3.98*	*76.5*	*5.39*	*6.18*	*3.37*	*54.2*	*18.48*	*9.06*	*49.0*	*26.32*	*10.31*	*39.1*	*51.69*	*149.2*
13.8	4.6	3.4	65.6	4.9	5.4	2.8	47.1	17.5	8.3	43.9	24.2	9.0	34.8	45.5	117.
15.7	5.7	4.7	88.5	6.1	6.9	4.1	65.0	20.6	10.3	55.9	29.8	11.5	42.7	58.0	199.

FEMALES.

Diam. bizygom max.	Nose: height to nasion	Nose. width max.	Nasal Index	Mouth, width	Left ear, length	Left ear, width	Ear Index	Left hand, length	Left hand, width	Hand Index	Left foot, length	Left foot width,	Foot Index	Weight
13.9	5.0	4.2	84.0	5.4	6.4	3.2	50.0	17.5	8.0	45.7	24.0	10.1	42.1	(135.)
13.4	4.7	3.3	70.2	5.3	5.6	3.6	64.3	17.8	7.6	42.7	23.6	8.9	37.7	(105.)
13.8	4.8	3.6	75.0	5.2	5.5	3.0	54.5	16.3	7.6	46.6	24.0	9.0	37.5	(150.)
13.6	5.1	3.8	74.5	5.2	6.8	3.4	50.0	16.2	7.5	46.3	22.3	10.0	44.8	(115.)
14.0	5.2	3.8	73.1	5.2	5.8	3.0	51.7	17.6	8.1	46.0	24.3	9.7	39.9	(115.)
12.8	5.0	3.2	64.0	4.6	5.5	3.2	58.2	16.7	7.5	44.9	22.4	8.6	38.4	(105.)
14.6	5.2	4.3	82.7	4.3	7.3	3.3	45.8	20.1	8.7	43.3	27.8	10.5	37.8	(195.)
13.4	5.0	3.5	70.0	4.4	5.6	3.2	57.1	16.5	7.8	47.3	23.0	10.0	43.5	(125.)
13.2	4.3	3.7	86.0	4.6	5.9	3.1	52.5	16.8	7.9	47.0	24.1	8.7	36.1	(130.)
13.1	4.9	3.4	69.4	4.9	5.9	3.2	54.2	16.9	7.8	46.1	23.8	9.0	37.8	(125.)
14.8	4.8	3.3	68.8	5.3	5.6	3.2	57.1	16.9	8.0	47.3	23.7	9.1	38.4	147.
14.1	5.1	3.6	70.6	5.2	6.0	3.0	50.0	16.3	7.4	45.4	23.5	9.5	40.4	(105.)
12.7	4.9	3.1	63.3	5.3	6.2	3.4	54.8	16.7	7.7	46.1	23.6	9.0	38.1	(105.)
14.3	4.9	3.9	79.6	4.9	5.6	3.2	57.1	17.9	8.2	45.8	23.7	8.8	37.1	(135.)
13.4	4.7	3.4	72.3	3.4	5.7	3.1	54.4	17.0	7.7	45.3	24.5	9.0	36.7	155.
13.1	5.1	3.6	70.6	5.0	6.2	3.1	50.0	16.4	7.5	45.7	22.0	8.5	38.6	(100.)
14.0	4.9	3.4	69.4	4.6	5.5	3.0	54.5	16.8	7.7	45.8	23.5	8.5	36.2	104.
13.7	*4.92*	*3.59*	*73.5*	*4.9*	*5.94*	*3.18*	*53.5*	*17.08*	*7.80*	*45.6*	*23.75*	*9.22*	*38.8*	*135.3*
12.8	4.3	3.1	63.3	3.4	5.5	3.0	45.8	16.2	7.4	42.7	22.0	8.5	36.1	104.
14.8	5.2	4.3	86.0	5.4	7.3	3.6	64.3	20.1	8.7	47.3	27.8	10.5	44.8	155.

of western Alabama and southeastern Louisiana, and despite a fairly uniform language certain cultural differences were found throughout the area. For such a large tribe to be homogeneous would be a great exception. But the Choctaw are known to have incorporated some of the smaller neighboring tribes and doubtless similar merging had taken place in the more remote past. This, together with a normal amount of mixture due to contact with adjoining tribes might well have brought about some changes in the original type. Moreover the numbers now studied are not large enough to be safely regarded as fully representative of the tribe; they may show localized differences. It is hoped that added observations may be made in the near future on both the Choctaw and other remnants of the more important tribes of the Southeast.

An analysis of the other measurements is hardly called for in this place and with the numbers at our disposal. The data will be given instead, for what they may be worth, in detail, until the study can be made more comprehensive.

CORRESPONDENCE

DEFINITION OF "VARIATION"

Every anthropologist and biologist believes he knows what is organic *variation*—until he attempts to define it to his own and others' full satisfaction; then he finds himself in difficulties.

It is easy to comprehend variation as the sum of structural differences, and to divide these into inherited and acquired; but what the phenomenon of variation really is, what are its causes, meaning, potentialities and technique, and what are its relations to mutation, heredity, and evolution elude the grasp and hence closer definition.

This dilemma presented itself forcibly to the undersigned during a course of lectures on Human Variation which he gave under the auspices of the U. S. National Museum in the latter part of last year; and finding no thoroughly satisfactory treatment of the subject in the available publications he turned for help to a number of the foremost workers in Biology, Genetics and Anthropology, with the following letter:

"Dear ———

I turn to you as to one of the foremost representatives of your branch of science for the following:

Please give me your present definition of *Variation*. I shall naturally wish to quote the definition. Also kindly refer me to any other noteworthy definition of the subject that you know of.

The "variation" a definition of which I am seeking is the normal variation within a species.

Yours, etc."

All the addressees have kindly responded in time, and their answers are of much interest as showing more palpably than ever the difficulties of the proposition. True as the given definitions are, none of them touches the kernel of the question and we end by still asking, What is the normal, inborn, human (or organic) variation? Or, how shall we understand and define the phenomenon that every limb, part and characteristic of the human body (as well as those of all other organisms), occurs invariably and even under the best conditions as to normalcy and parity of a group, not as a single value but as a well regulated range of grades the charting of which gives us not a point but regular symmetric curve of distribution?

The understanding of this normal inborn variation, the range of which differs with the different characters, but is much the same for the same character in different groups of the same species and possibly even further, would, it seems, be of the utmost and fundamental significance.

A. Hrdlička

The answers received are given in the alphabetical order of the authors' names:

W. Bateson.—"I have nothing to offer you in the way of a definition of Variation which quite satisfies me. When your letter came I read it to the group of students who work here and several of us tried our hands at supplying such a definition. These were read out, the names of the authors being suppressed, and a company of thirteen voted as to which, in their opinion, was the best. Mine, which I enclose herewith, received no votes. Nevertheless I consider it very much the best. At the same time I also enclose the two which were preferred, one of which in the final scrutiny received eight votes and the other five.

"You no doubt are wishing the definition should be drawn so as to distinguish between variation and "mutation." This I am unable to do. I have never been able to attach a clear signification to the word "mutation" and from what I see of the writings of others I conclude they are no better placed in that respect than I am."

Variation, within a Species,[1] is used to denote,

(1) Any difference between individuals composing that species: in genetics used especially of those congenital differences by which evolution is supposed to continue.

(2) The process by which such differences arise. These two senses are commonly confused, and the existence of variation in sense (1) is generally assumed, wrongly, to be evidence of the contemporary operation of the process denoted in sense (2).

This was my own attempt, which received no votes.—W. B.

The following received five votes after all but Nos. 4 and 10 had been eliminated:

Normal variation within a species.

The description of the kind of variation of which a definition is required begs two, if not more, questions. If, however, the difficulty of defining species is passed, is not the variation within a species a peculiarity of that particular species and not an adjunct of its rank as such? Samuel Butler said "Some stocks do and some stocks don't" and there is a good deal to be said for such a view.

Variation has been used in the past to apply to diversity among related organisms in an inclusive sense, so that the demand for a new definition probably envisages the removal of certain categories of diversity which would have been excluded by the earlier users of the word, had those categories been as well understood then as they are now. A redefinition which will exclude segregation and recombination involves changing the reference of the word from diversity expressed in the organism to diversity implicit in the germinal constitution. This involves excluding modifications and fluctuations and leaves the word restricted to what are now called mutations while any diversities that have not been studied or have not been understood must have a provisional place. It is extremely unlikely that any new category of diversity that may be discovered will escape baptism. The logical course, therefore, seems to be to retain variation in its widest sense and to have a more precise word for each kind of diversity it includes.

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[1] Previous definition of Species is presumed.

Definition. Variation is diversity, of whatever kind and from whatever cause arising, in organisms known or believed to belong to a stock at one time homogeneous.

This received 8 votes after all but Nos. 4 and 10 had been eliminated.

Variation is the departure in any direction from the typical characters of the species, whether structural or functional, occurring in one or many characters and in large or small respects.

Apart from non-inheritable fluctuations which are merely the response of the individual to its environment, variation is the result of a change in the hereditary factors of the organism, such as the omission, addition, interaction and fractionation of genetic factors.

E. G. Conklin.—In reply to your letter of Feb. 16th, I must say that it is always very difficult to frame a definition of general terms such as *variation* or *heredity.*

Variation in general means any departure from a particular type. Variations are of two kinds, (1) *mutations*, which are inherited and are due to changes in the hereditary constitution and, (2) *fluctuations*, which are not inherited and are due to environmental modifications of the soma.

Any heredity variation which breeds true may be called a mutation. If it is due to a new combination of chromosomes or parts of chromosomes, it is called a *chromosome mutation.* If it is due to a modification of a gene, or inherited factor, by changes in its constitution, it is known as a *gene mutation.*

I don't know whether such an explanation as this will constitute a definition, but it is practically impossible to give a brief definition that will be sufficiently accurate and inclusive.

H. S. Jennings.—In the case of such a matter as *variation* I find that for my purposes the best method is, not to seize upon the term and attempt to give it a single hard and fast definition, but rather to attempt to distinguish and describe, as well as I can, the different things that are commonly included under that term. The "variation curve" of the biometrician, for example, obviously includes a large number of distinguishable things. Aside from the obvious differences of growth, sex, and transient effects of different environments, the matter presents itself somewhat as follows to me.

Any species that has been carefully studied consists of a large number of slightly differing individuals, the differences between which (some of them at least) are hereditary; that is, they persist from generation to generation. This comes out sharply in those organisms in which uniparental reproduction may occur for a number of successive generations, —by parthenogenesis, vegetative multiplication, self fertilization or the like. We get in all such cases a lot of slightly diverse sets, all the individuals of each having apparently the same germinal constitution, and differing only as to age and transient environmental effects.

I am accustomed to call these different sets, each with the same germinal constitution, diverse *biotypes*. Now, when these enter upon biparental reproduction, one finds that the germinal constitutions fractionate and new combinations of the parts or genes are made at every fertilization. So the organism multiplying by biparental reproduction also consists of great numbers of diverse biotypes which alter through recombination at every generation. It appears to me that the fact that a species is composed of a large number of diverse biotypes, altering by recombination of genes at every sexual reproduction, is what is often meant by the normal *variation* of a species.

But of course the question comes as to how it happens that there *are* a lot of diverse units or genes in a species, such as to make it possible for many diverse combinations to occur. This demands that there should occur actual changes in the genes or units of the germinal constitution; and I have become accustomed to use the word *variation* as a name for these changes in the germinal substratum as distinguished from mere Mendelian recombinations. I commonly couple with it, however, the word hereditary or inherited, speaking thus of "inherited variations." Some of these changes are apparently chemical alterations in a single unit,—what Morgan calls gene mutations. Others are the result of some accidental or nontypical alteration in chromosomes, as when a chromosome or a part of one, is destroyed or lost or doubled. Others apparently occur under the direct influence of the environment; just what is taking place in these cases is not clear. There are many of these alterations in hereditary characters—persisting from generation to generation in vegetative reproduction—whose nature is quite unknown. Further definition waits upon further investigation.

Of course after these variations have occurred and been inherited by offspring, they constitute what I have above called biotypes.

I do not think that all this will be satisfactory to you, nor serve the purpose which led you to write to me. But I didn't volunteer, and since you have asked me to express myself, I can do so only by setting forth the way the thing appears to me, with an outline of my method of dealing with these matters.

John E. Merriam.—Dr. Merriam received your note of February sixteenth before leaving recently for Yucatan and had hoped to be able to send you a prompt reply. He did not have opportunity, however, to write such a careful definition of "variation" as you desire and has moreover asked me to say that definitions of this term are subject to change according to the points of view regarding the method of evolution. He would be inclined to take a combination of views represented by the work of such men as T. H. Morgan, C. B. Davenport, and W. D. Matthew, and he would suggest that you write to these men on this subject.

He regrets that at this time it does not seem possible for him to state the case more fully. W. M. Gilbert.

T. H. Morgan.—In reply to your question, concerning a definition of *Variation*, I infer that you mean, of course, biological variation. I also take for granted you did not expect me to give a definition that is anything more than a description of certain results of experience, and therefore one subject to change as our information becomes greater. Furthermore, any definition of this kind may be an attempt to sum up our objective information, or it may attempt to include some information as to the causes of the variation in general, or of specific variations in particular. In regard to the former, I can only say that by variation we mean something different from something else; this something else may be a standard type, arbitrarily chosen, or the result of some prior observation, or the result of some calculated mean or modal class, etc. In regard to the latter, I can only say, with some reservations, that we recognize at present biological variation as arising from environmental effects met with in the course of development, or from effects due to different re-combinations of genetic factors, or from new effects produced by a change of some sort in the germinal material.

Henry Fairfield Osborn.—Thanking you for your letter of February sixteenth, it does not seem possible now to give a single definition of Variation. It seems to me a comprehensive term, introduced by Darwin and Wallace, which now covers a host of differences between animals and plants, partly germinal, partly environmental, partly habitudinal, in origin. For example, the variation in wing measurement in birds may express differences between the lethargic type, which uses its wings as little as possible, and the very active type, which uses its wings a great deal. Compared, for example, with the arms and legs of soldiers and sailors, such variations are habitudinal.

As I conceive the word now, it should be absolutely confined as in Darwin's original usage to *variations that are germinal in origin and may therefore be hereditary*—such examples as occur in the proportions and cuspules of the teeth.

I trust this in some measure answers your difficult question.

Raymond Pearl.—In reply to your letter of February 16th, let me first say what you know as well as I do that in regard to most concepts if one makes a definition of scientific accuracy, it is apt to be meaningless or nearly so. If, on the other hand, one tries to make a definition which shall have really some content of useful meaning, it is apt to be open to criticism on the score of complete accuracy.

With so much preliminary, I should define variation in this way:

Variation is the word used in the biological sciences to name the observed fact that no two individual organisms are precisely alike.

I have a strong suspicion that this is not the kind of definition that you want, but it is about the only one that I know of that would seem to me scientifically precise and exact.

You will find a general discussion from a somewhat philosophical point of view of the concepts of variation and inheritance in the first chapter of my book "Modes of Research in Genetics," which was published some ten years ago.

Karl Pearson.—Dr. Pearson says: "I have nothing to communicate for publication on the subject of variation beyond what will be found in my published papers;" and then proceeds with a very interesting letter which under the above restriction cannot be used.

MENDELISM AND CEPHALIC INDEX

PROF. WATSON KIRKCONNELL
Wesley College, Winnipeg

One of the most serious challenges to the conception of the cephalic index as an approximate racial constant has come with the claim (cf., e.g., Franz Boas, "*The Immigration Commission*," U. S. Senate Document, No. 208, 1910, and "*Changes in Form of Body of Descendants of Immigrants*," 1911.) that an empirical study of American immigrants proves environment to be capable of altering skull-shape fundamentally in a single generation. According to Dr. Boas, neither brachycephaly nor dolichocephaly is transmitted by immigrant parents of these cranial types. Their children tend, on the contrary, to develop mesocephalic skulls irrespective of the parental extraction.

Were this moulding influence of environment actual, the orthodox classification of races and sub-races on a basis of cephalic indices would obviously be invalidated almost completely. The distinction between Nordic and Alpine indices, for instance, might well come to be regarded simply as a recent differentiation due to changes in habitat.

To object to this theory because of its heterodoxy would of course be wholly unfair and unscientific. My own experience has led me, however, to question whether the methods of collecting and interpreting the data in the case may have neglected some essential and contradictory factor.

My own family record, for instance, is in flat opposition to the environmental theory. All of my ancestors have lived in the same locality (the low, southern part of the Canadian province of Ontario) for over a century; yet my father and mother emerged with cephalic indices of 85 and 72 respectively! Five children have been born to them, with adult cephalic indices (in order of age) of 82, 85, 68, 73, and 83. In other words, three are distinctly brachycephalic like the father and two hyperdolichocephalic like the mother.

These cases are doubtless too few to yield any very cogent induction. Nevertheless I cannot for a moment reconcile them with the Boas theory. Identity of environment for more than a century has not produced a common intermediate type but rather the contrary. And in the last generation the cephalic characters of father and mother have been so potent that each has stamped certain of the children as peculiarly brachycephalic or dolichocephalic.

The case becomes quite intelligible, however, if we suppose that the Mendelian laws of heredity are in operation and that the characters of father and mother tend to segregate or "mendelize" out in the offspring. This assumption is strengthened by the fact that in the family in question those children of the same cranial type of the mother resemble her also in most other characteristics, both somatic and psychic, while those of the paternal cranial type resemble him also in body and in temperament.

The instance is, I must repeat, too isolated to be conclusive; but certainly the Mendelian explanation would seem here to be the only one with any meaning at all.

RECENT MOVEMENTS OF PEOPLES IN MACEDONIA

The Hon. Secretary of the Anglo-Hellenic League, (53–54, Chancery Lane, London, W. C. 2.) has received from Mr. A. A. Pallis a pamphlet (in Greek) containing a statistical study of the racial migrations in Macedonia and Thrace from 1912 to 1924. The following pages contain extracts from this pamphlet. The figures can be relied on as the most accurate obtainable.

MACEDONIA

1. 1912. About 10,000 Turks leave on the Serbo-Bulgaro-Greek advance.
2. 1913. Practically all the Bulgarians (15,000) leave the Kilkish District on the retirement of the Bulgarian army.
3. 1913. After the signature of the Treaty of Bucarest about 5000 Greeks leave Bulgarian Macedonia (Strumenitsa &c.) for Greek Macedonia.
4. 1913. Similarly about 5000 Greeks migrate from Monastir &c.
5. 1913. About 5000 Greeks arrive from the Caucasus.
6. 1913–14. About 40,000 Greeks arrive from Western (Bulgarian) Thrace.
7. 1914. As a result of the Young Turk propaganda 100,000 to 115,000 Turks leave Macedonia.
8. 1914. About 2000 Jews leave Macedonia (out of 76,000).
9. 1914. As a result of Turkish pressure in connection with the Aegean Islands about 80,000 Greeks arrive from Thrace and 20,000 from Asia.
10. 1916. 36,000 Greeks are driven into Bulgaria from Bulgarian Eastern Macedonia.
11. 1918. After truce with Bulgaria only 17,000 of above return.
12. 1917. As a result of Salonika fire 6,000 Jews leave.
13. 1918–19. Greeks occupy Thrace. Refugees from these districts return from Macedonia to the number of 140,000.
14. 1919–20. 53,000 Greeks arrive from S. Russia and 2,000 from Caucasus.
15. 1919. About 1,000 Russians arrive after Wrangel's defeat.
16. 1918–20. About 3,000 Greeks arrive from N. Epirus.
17. 1919–24. About 27,000 Bulgarians leave after Agreement as to Exchange of Populations. Probably about 10,000 more will leave.

18. After Greek defeat in Asia Minor and the Mudania Conference, about 700,000 Greeks arrive in Macedonia and 120,000 in W. Thrace (to 1st. Nov., 1924).
19. 1923–24. After Lausanne Treaty about 348,000 Turks leave (to Nov. 1).
20. May to Dec. 1924. As a result of agreement as to exchange 94,000 Greeks arrive from Asia Minor, 18,000 from E. Thrace, and 38,000 from Constantinople. (E. Thrace includes Chatalja district).

(Note. After 1912 about 10,000 Greeks arrive from "Old" Greece).

WESTERN THRACE

1. 1913. Bulgarians drive out 70,000 Greeks.
2. 1913. Turco-Bulgarian Agreement. About 49,000 Turks leave.
3. 1919. 51,000 Greeks return.
4. 1920–24. 5,000 Greeks arrive from Bulgaria and the Caucasus, 116,000 from Turkey. Also 4,000 Armenians and Circassians. Of these about 99,000 have been established. 12,500 Bulgarians leave.

During 1925 all Bulgarians will probably have left to be replaced by Greeks from Bulgaria, of whom about 20,000 are expected.

EASTERN THRACE

This refers to that part of Thrace allotted to Greece under Sèvres Tr.

1. 1912. About 104,000 Turks leave on arrival of Bulgarians.
2. 1913. About 2,000 Bulgarians leave when Turks reoccupy E. Thrace.
3. 1914. About 132,000 Turks arrive from the other Balkan States.
4. 1913–14. 49,000 Turks arrive from Bulgarian Thrace (exchanged).
5. Similarly 47,000 Bulgarians leave E. Thrace.
6. 1914. 115,000 Greeks driven out.
7. 1915–16. 85,000 more Greeks driven out, and 17,000 Armenians.
8. 1918–20. 50,000 Greeks arrive from Asia and 83,000 from Greece.
9. At end of 1922 only 1,200 Greeks left. These were exchanged by 1924. The same happened to the Armenians. 70,000 Turks arrive.

CHATALJA DISTRICT

Greek population of 17,404 exchanged (June, 1924). No Greeks left.

TABLES

(Note. 000's omitted.)

Macedonia

	1912	1913	1915	1920	1924
Greeks	513	528	678	577	1277
Bulgarians	119	104	104	104	77
Turks	475	465	350	350	2
Others	98	98	96	91	91
TOTAL	1205	1195	1228	1122	1447

W. Thrace

	1912	1915	1920	1924
Greeks	87	17	68	189
Bulgarians	35	35	35	23
Turks	111	84	84	84
Others	4	4	4	8
TOTAL	237	140	191	304

E. Thrace

	1912	1916	1920	1924
Greeks	253	53	186	0
Bulgarians	50	1	1	1
Turks	223	300	300	370
Armenians	24	7	7	0
Others	19	19	19	19
TOTAL	569	380	513	390

NOTES

The *First International Congress on Child Welfare* was held at Geneva, Switzerland in August. It was attended by approximately 300 delegates.

The *Third Pan-Pacific Science Congress*, including a Section on Anthropology will be held in Tokyo from Oct. 27 to Nov. 9, 1926.

Mr. Harry L. Shapiro, of Harvard, a pupil of Prof. E. A. Hooton, has been appointed Assistant Curator of Physical Anthropology at the New York Museum of Natural History.

Dr. Sergio Sergi, son of Giuseppe Sergi, has been named a titular Professor of Anthropology at the Royal University at Rome, and Director of the Anthropological Institute of the University.

Dr. Adolph H. Schultz has been appointed Assistant Professor of Physical Anthropology at the Medical School of Johns Hopkins University. Due to the prominence of this School, the appointment is of much importance and promise; and the time is probably not far distant when other medical schools in this country will find the inclusion of Physical Anthropology into their curriculum a growing necessity.

Dr. Hrdlička has returned from his trip to the Far East. The trip which occupied nearly seven months, was devoted essentially to a survey of conditions, sites and materials, of interest to physical anthropology, with particular attention to everything relating to human and primate ancestry. The journey embraced India, Ceylon, Java, Australia and South Africa. Among the sites visited were those of the Pithecanthropus, the Rhodesian man and that of the recently discovered Taungs (Bechuanaland) fossil great ape. A number of important racial questions—the identity of the 'Aryans', the Negritos in India, the Australians and Tasmanians, the Bushmen, Strandloopers and Hottentots—have also received attention.

A NEW GERMAN PERIODICAL. A monthly magazine entitled *Volk und Rasse* and devoted to the anthropology and eugenics of Germanic peoples, is announced by J. F. Lehmanns Verlag of Munich. The editor is Privatdozent Dr. Walter Scheidt, of the Ethnological Institute, Hamburg, who is assisted by a board of specialists. The preliminary announcement states that the new magazine is based on the thought that "all social and cultural changes of a people are closely associated with its hereditary make-up."

(*J. Hered.*, XVI, No. 9, 1925.)

NEW PERIODICAL. The Anthropological and Ethnological Society of Switzerland announces the foundation of a new anthropological periodical, the "*Bulletin der Schweizerischen Gesellschaft für Anthropologie und Ethnologie*." The first number, issued October 9, 1925, contains a short history of the foundation of the Society with its by-laws and list of members as well as a résumé of anthropological communications to the Society for 1924–25. For the present it is intended to have the Bulletin appear annually but to develop it so that it may soon bring small memoirs, a bibliographic record, etc. The cost of each copy of the Bulletin is fixed low—one Swiss franc. Address: *Anthropologisches Institut*, Universität, Plattenstrasse 9, Zürich 7, Switzerland.

A NEW EUGENICS JOURNAL. The Galton Laboratory of National Eugenics, University of London, announces the forthcoming appearance of a new periodical, to be called *Annals of Eugenics*, a Journal for the Scientific Study of Racial Problems. It will be edited by Karl Pearson, assisted by Ethel M. Elderton, and will be printed by the University Press, Cambridge. The size is given as large quarto, and an annual volume will consist of some 400 pages with plates and tables. The subscription price has been set at 50 shillings.

(*J. Hered.*, XVI, No..9, 1925.)

GRANTS TO THE AMERICAN JOURAL OF PHYSICAL ANTHROPOLOGY. Shortly after the commencement of the publication of this JOURNAL the prices of printing, engraving etc. began to rise until they have doubled or more than doubled. This resulted in a good-sized yearly deficit which it has been and still is impossible to cover adequately from the subscriptions. Under these conditions it was necessary to turn to friends and other sources with requests for help, and in course of time contributions were received from a number of persons whose generous aid has already been individually and is hereby once more gratefully acknowledged. The contributors up to this year comprise Drs. George E. Hale, George A. Kober, Irving Fisher, J. H. Kellogg, Mr. John H. Patterson, Dr. George Grant MacCurdy, Mr. Philip A. Means, and Mrs. Mary Hooton. Besides this, in 1919 the JOURNAL received a grant of $200 from the American Association for the Advancement of Science. In the course of the present year the Editor is happy to ackowledge with thanks the following effective donations: Mrs. Mary Hooton, $200; American Association for the Advancement of Science, $250; and the National Academy of Sciences, $250. In addition a number of Institutions and authors have contributed to the cost of the publication of their illustrations and tabular matter.

SCIENCE AND FAITH

On October 28, 1925, the National Council of the Congregational Churches of U. S. A., adopted unanimously the following enlightened resolution:

"Resolved that we pledge ourselves to the conservation of the spiritual values embodied in the time-honored statements of Christian truth, but believe that God makes himself increasingly known through the patient investigations of modern scholars;

We declare our conviction that there is and can be no conflict between science and religion. We deplore any attempt of the State or Federal Governments to interfere with the teaching of widely accepted scientific theories, and encourage all reverent students in their search for the truth in whatever field, assuring them that we welcome all light that God can give us, and commend to our ministers and people the preaching and acceptance of a gospel consistent with modern scholarship."

OBITUARIES

✠ Louis R. Sullivan. In the death of Louis R. Sullivan, American Physical Anthropology in general and the American Museum of Natural History in particular lose a bright young worker of much promise. He was born in Houlton, Maine, May 21, 1892, and died on April 23, 1925. Like Frank Russell of Harvard, to whom he bore not a little resemblance in brightness, earnestness, character of work and disregard of self, he died of pulmonary trouble, an end which in both instances, had there been willingness to give up work for a few years and attend to physical restoration of self might probably have been averted.

Sullivan studied at Bates (A.B.), Brown (A.M.) and Columbia. He was Instructor in Zoology and Botany at the Tilton Seminary, 1914–15. In 1916–18 he was Assistant Anthropologist, and since 1918 Assistant Curator of Anthropology at the American Museum of Natural History, New York. In addition he served from 1918–19 as Assistant Anthropologist, U. S. Army, and since 1918 was also Research Associate in Anthropology on the Bishop Museum Expedition to Polynesia. His main but unfinished work was that on the somatology of the Polynesians. But he was interested also in other important branches of Physical Anthropology and was largely instrumental in preparing the exhibits of the Hall of Man in the American Museum.

BIBLIOGRAPHY OF LOUIS R. SULLIVAN.

Variations in the Glenoid Fossae. *American Anthropologist*, 1917, n.s., XIX, No. 1.

Growth of the Nasal Bridge in Children. *Ibid.*, No. 3.

Racial Types in the Philippine Islands. *Anthrop. Papers, Am. Mus. Nat. Hist.*, 1918, XXIII, Part 2.

The Bearing of Physical Anthropology on the Problem of Orthodontia. *Dental Cosmos*, Apr. 1918.

The "Samar" United Twins. *Am. J. Phys. Anthrop.*, 1919, II, No. 1.

The Pygmy Races of Man. *Natural History*, 1919, XIX, No. 6.

Anthropometry of the Siouan Tribes. *Proc. Nat. Acad. Sc.*, 1920, VI, No. 3; *also Anthrop. Papers, Am. Mus. Nat. Hist.*, 1920, XXIII, Part 3.

The Fossa Pharyngea in American Indian Crania. *Am. Anthropologist*, 1920, n.s., XXII.

The Status of Physical Anthropology in Polynesia. *Proc. First Pan Pacific Sc. Congr.*, 1921, Part 1. (Bernice P. Bishop Mus. sp. publ., Honolulu, 1921.)

The Physical Characteristics of the Two Prehistoric Chilean Miners. *Natural History*, 1921, XXI, No. 5.

A Few Andamanese Skulls with Comparative Notes on Negrito Craniometry. *Anthrop. Papers, Am. Mus. Nat. Hist.*, 1921, XXIII, Part 4.

A Contribution to Samoan Somatology. *Mem. Bernice P. Bishop Mus.*, 1922, VIII, No. 4.

A Contribution to Tongan Somatology. *ibid.*

The Frequency and Distribution of some Anatomical Variations in American Crania. *Anthrop. Papers Am. Mus. Nat. Hist.*, 1922, XXIII, Part 5.

Marquesan Somatology with Comparative Notes on Samoa and Tonga. *Mem. Bishop P. Bernice Mus.*, 1923, IX, No. 2.

The "Blond" Eskimo—a Question of Method. *Am. Anthropologist*, 1922, n.s., XXIV, No. 2.

Essentials of Anthropometry. *Am. Mus. Nat. Hist., Sp. Publ.*, 1923.

New Light on the Races of Polynesia. *Asia*, Jan. 1923.

Race Types in Polynesia. *Am. Anthropologist*, 1924, n.s. XXV, No. 1.

Relationships of the Upper Palaeolithic Races of Europe. *Natural History*, 1924, XXIV, No. 6.

With Katherine Murdoch:

A Contribution to the Study of Mental and Physical Measurements in Normal Children. *Am. Phys. Education Rev.*, May and June, 1923.

Some Evidence of an Adolescent Increase in the Rate of Mental Growth. *J. Educational Psychology*, Sept. 1922.

With Milo Hellman:

The Punin Calvarium. *Anthrop. Papers Am. Mus. Nat. Hist.*, 1925, XXIII, Part 7.

✠ **Rudolph Martin.** In the death of Rudolph Martin, on July 11 of this year, Physical Anthropology loses prematurely one of its most outstanding and able workers. Martin was in more or less ill health for many years, even before he left Zurich. He suffered, besides other things, from headaches which interfered seriously with his work. That under these infirmities he accomplished as much as he did is so much more to his credit. His main services to Anthropology were his development of the Zurich school, where most of the living younger anthropologists of the German-speaking and neighboring countries obtained instruction; and his production in 1914 of the *Lehrbuch der Anthroplogie*, which with the older *Élements d'anthropologie générale* by Topinard constitutes one of the two principal textbooks of Physical Anthropology.

Rudolph Martin was born of German (Baden) parents in Zurich, July 1, 1864, and became an Associate Professor of Anthropology at the

University of that city in 1889, and regular Professor in 1905. It was during this period that he developed his department into the Anthropological Institute and brought to such prominence his School of Anthropometry.

In 1911 for a complex of reasons he severed his connection with Zurich and removed to Paris where until 1914 he worked on his handbook. After the war broke out however he was obliged to return to Switzerland and passed on to Germany where later for a time he was connected with the Department of Anatomy at the University of Jena. In 1917, following the death of Johannes Ranke, he was called to the Chair of Anthropology at the University of Munich and remained there, in fruitful work, until his decease. Here, in 1924, he established the *Anthropologisches Anzeiger*, which promised much under his guidance.

A full bio- and bibliography of Martin is doubtless being prepared by his colleagues or pupils. So far a brief obituary has appeared in the *Anzeiger* and a more extended but still very incomplete one by Karl Saller, in the *Münchener Mediz. Wochenschrift* of August 7, 1925, 1343–'4.

It is fortunate for Germany that it possesses a sturdy, able scientific progeny in Anthropology, for without such the losses it has sustained in the last decade would be blighting.

✠ William Curtis Farabee. On June 24 of this year, after a long illness, death claimed Dr. Farabee, Curator of American Archaeology and Ethnology, University Museum, Philadelphia; anthropological explorer and author of note, and an Associate Editor of this Journal. Dr. Farabee died a victim to pernicious anaemia, incurred during his 1922 expedition to southern Peru, one more of the long honorable line of those who have paid for the acquisition of new knowledge with their life.

Dr. Farabee was always directly and earnestly interested in Physical Anthropology. Born in 1865, he obtained his degree of Ph.D. at Harvard in 1903, and for the next ten years remained connected with the anthropological department at Harvard and the Peabody Museum. From 1913 to the end he was connected with the University Museum in Philadelphia. His explorations and work related essentially to the Indians of northern South America and Peru. His two main works are books on "The Central Arawaks" and "The Central Caribs". After the World War he served as an expert on ethnic questions with the United States Peace Commission, and he was the U. S. Government representative at the Independence Centenary of Peru. Personally Dr. Farabee was of an open, friendly, warm-hearted, helpful disposition, and a tireless worker.

ERRATA

In the article "The Pterion in Primates," Vol. VIII, No. 3, the headings "Pterions With Both Sides" in the tables are incorrect. "Pterions With" was given the wrong position; the correct form is "Pterions With Temporo-Frontal Articulations," "Pterions With Spheno-Parietal Articulations," etc.

Bottom of Page 207, same article, 147 should be 152.

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